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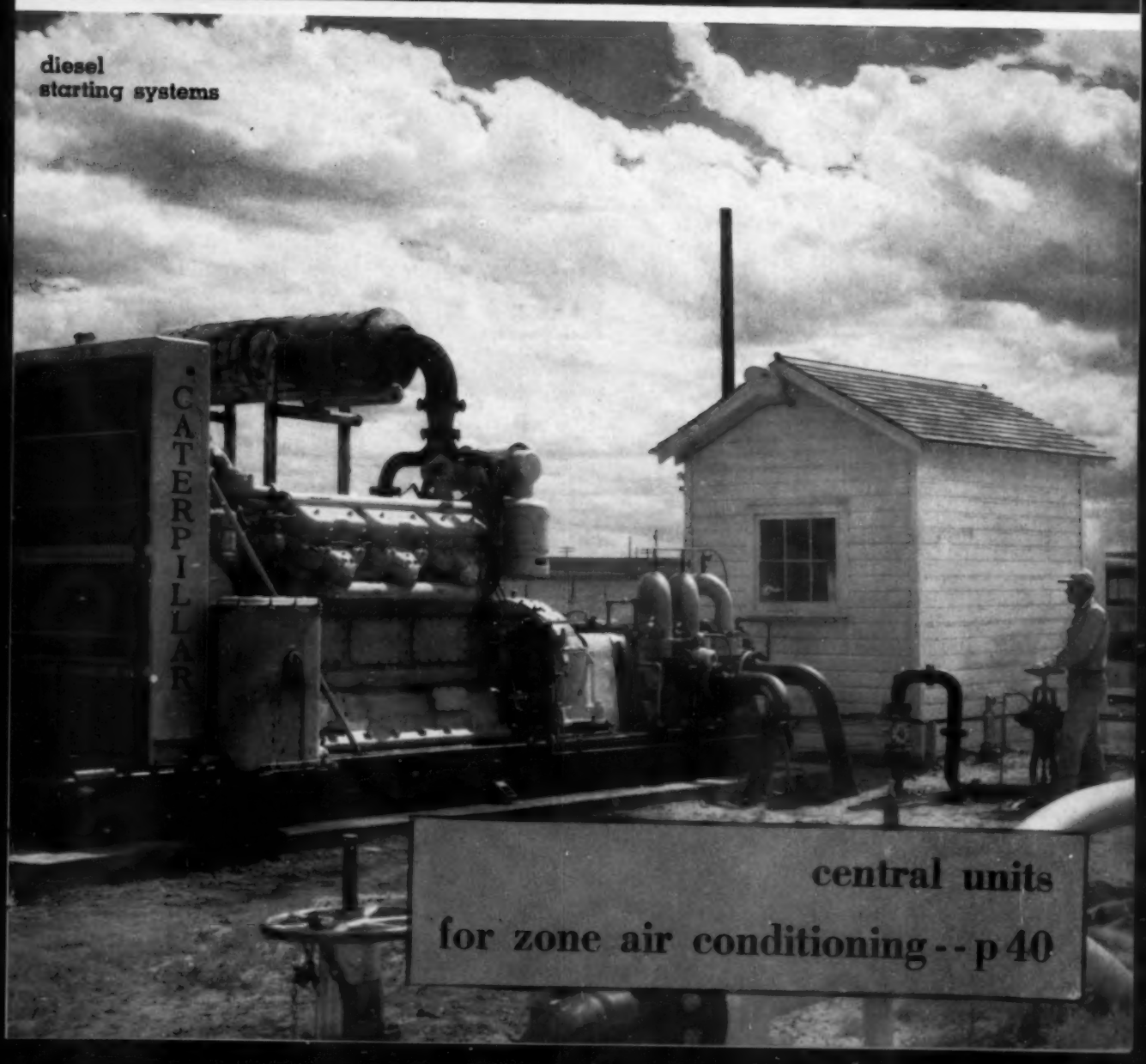
MARCH 1958

Industry & Power



40 YEARS OF KNOW-HOW

During all these years we have been advocating higher interior distribution voltages and the installation of SORGEL dry-type transformers inside of buildings, at load centers, to provide greater efficiency and economy. This is now recognized as the best and most practical method of electrical distribution. SORGEL dry-type transformers are not just ordinary transformers that were converted to follow the trend toward air-cooled transformers. SORGEL dry-type transformers are designed and constructed especially for this purpose.

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Rugged construction—All fabricated steel frames and enclosures. No castings or flimsy enclosures.

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Trouble-free, and years of continuous hard service.
Safe, low operating temperature.

Complete Line

¼ Kva to 2500 Kva single phase.
1 Kva to 3000 Kva 3-phase, 2-phase, and phase changing.

All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200, and up to 15,000 volts, and any intermediate or special lower voltage.

Also Special Transformers and Saturable Reactors

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Dry-Type
TRANSFORMERS

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Louisville, Ky.	Los Angeles, Calif.

Consult the classified section of your phone directory or write to the factory

Sales Engineers in Principal Cities

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40 years' experience in the development, manufacturing and application of transformers

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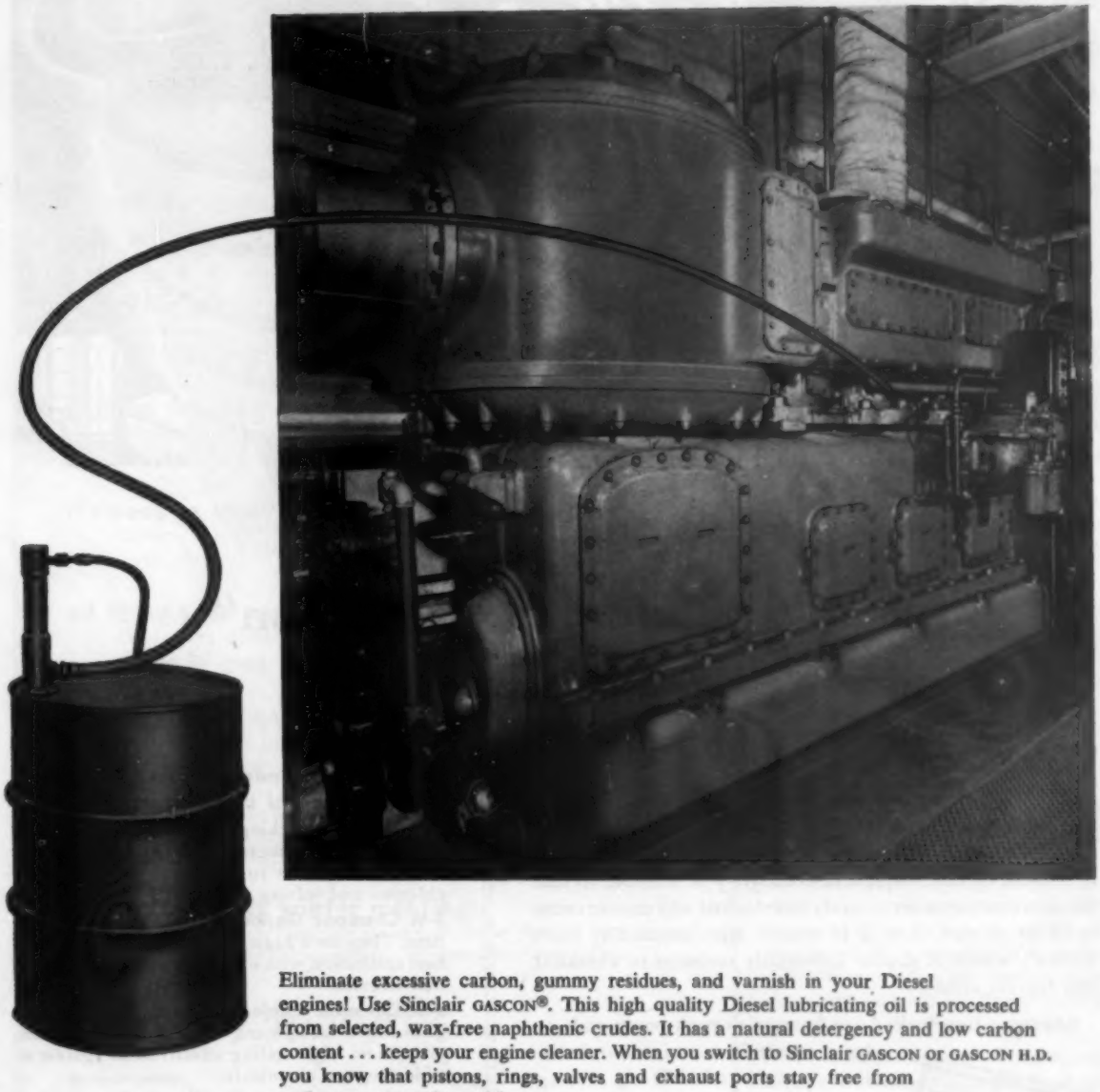
Check Carbon!



Eliminate excessive carbon, gummy residues, and varnish in your Diesel engines! Use Sinclair GASCON®. This high quality Diesel lubricating oil is processed from selected, wax-free naphthenic crudes. It has a natural detergency and low carbon content . . . keeps your engine cleaner. When you switch to Sinclair GASCON or GASCON H.D. you know that pistons, rings, valves and exhaust ports stay free from carbon, gums and varnish.

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SINCLAIR GASCON OILS

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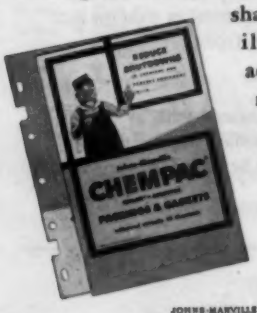
Now—J-M Chempac-Interlocked Packing combines both "Teflon" and asbestos protection

Johns-Manville now introduces Chempac®-Interlocked Packing, with three important advantages for service in chemical and process equipment. Interlocked provides the excellent sealing and heat resistant qualities of asbestos. It is braided by the unique and exclusive J-M method, so that the asbestos yarns are securely interlocked and cannot come apart in service. And it is treated with chemically inert Teflon*, which is almost universally resistant to chemical and solvent action.

Chempac-Interlocked can be used to pack pump rods or shafts, rotary filters, mixers and similar apparatus handling strong acids, alkalis, caustic solutions and many other reagents at temperatures to 500F.



Other J-M Chempac Packings and Gaskets for the Chemical and process industries

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*Trade Mark of DuPont Tetrafluoroethylene resin

Free Folder gives complete details on Chempac-Interlocked and other J-M Chempac Packings and Gaskets for the chemical and process industries. For your copy of folder PK-80A write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

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Johns-Manville PACKINGS & GASKETS

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Industry & Power

SERVING INDUSTRY'S POWER SERVICES

VOLUME 70 NO. 3 MARCH 1956

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Inside—Outside Topside!

MULTI-WASH DUST COLLECTORS need no productive floor space

Inside

How Multi-Wash collectors can be installed, up off the floor, inside the building.

Outside

Installation of collectors outside the plant, conserving floor space for productive work.

Topside

Battery of Multi-Wash units installed on the roof of a large production factory.

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economy in industrial boiler plants

Here is a quick rundown on boiler plant operation with but one thought in mind—operating economy. From initial design through operation, record-keeping, maintenance, purchasing, and manpower—this article pinpoints potential economy for you.

Author of this article is the assistant chief power engineer, power division, of one of the outstanding, pace-setting consulting engineering firms in the country. His experience with dozens of plants is yours when you read all about economy in industrial boiler plant operation in

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nuclear news

. . . about industry & power

SHIPPINGPORT FIGURES LEAP HIGH

Cost of power from the Shippingport (Pittsburgh) reactor being built for Duquesne Light will be about 52 mills per kwh – a far cry from the 7-to-9 mill per kwh level most nuclear power talk has considered critical. Biggest item contributing to the 52-mill figure is a 39-mill charge covering fuels. Some 10 years from now, technical developments are expected that will bring Shippingport's power down to 14 mills per kwh, figuring 6 mills for fixed charges, 9 mills for fuel, 1 mill for operating costs, and 2 mills credit for reclaimed fuels. Four paths to reducing the 59-mill figure are anticipated: making the reactor core last longer; packing more uranium into given space by developing a new alloy; reducing cost of raw material; and streamlining manufacturing processes.

SEVEN PROPOSALS MADE FOR SMALL POWER PLANTS

Seven proposals have been received by the AEC in response to its invitation for bids to develop, design, construct, and operate small capacity nuclear power plants. Capacities range from 2000 kw to 25,000 kw, one proposal ranging from 25,000 kw to 40,000 kw. Proposals were received from Chugach Electric Association, Anchorage, Alaska and Nuclear Development Corporation of America; from City of Holyoke Gas and Electric Department, Holyoke, Mass., and Ford Instrument Company; from City of Orlando, Florida; from City of Piqua, Ohio, and Atomics International of North American Aviation; from Rural Cooperative Power Association, Elk River, Minn., and American Machine and Foundry; from University of Florida, Gainesville, Florida; and from Wolverine Electric Cooperative, Hersey, Mich., Foster Wheeler Corporation, and Worthington Corporation.

WHAT ABOUT CONVENTIONAL FUELS?

What might happen to the future of conventional fuel industries if nuclear energy should become a significant source of power within the next few decades? Some interesting observations have come out of the report issued by the Panel on the Impact of Peaceful Uses of Atomic Energy, a group reporting to the Joint Congressional Committee on Atomic Energy. Acknowledging that nuclear power may displace power generated from conventional fuels, the

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By assigning the responsibility for result-getting water conditioning in your plant to the Betz Organization, you gain immediately the services of field, staff, and consulting engineers, researchers, chemists, and production personnel . . . *plus* the basic objectivity of an "outside" organization providing individual attention to your individual problems.

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Whether your problem requires boiler or cooling water conditioning, Betz completely-integrated service brings into play techniques, methods, and engineering that can make all the difference in *results*.

A Betz District Engineer, one of the many important members of the Betz service "team", will be happy to give you the details of our result-getting service. Why not call him in *today?*

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nuclear news

. . . starts on page 6

Panel goes on to say that even where atomic energy "does displace conventional fuels, those fuels may find uses that are more profitable to those who produce them and of greater value to the Nation's economy. The gasification of coal is a good example. Using atomic energy as the heat source for that process it may be possible to conserve our more limited and irreplacable petroleum resources." On the petroleum front, the Panel suggests that the oil industry could lose its entire electric-power-generation market, and yet find this loss offset by six months' normal increase in total petroleum demand. Natural gas might find more remunerative uses if its consumption by utilities was diverted to domestic and other uses. Railroads may find that their fear of losing their coal-hauling business to nuclear plants will be, in reality, more seriously affected by the trend toward generating electric power at the mine head. As for coal miners, the Panel suggests that mechanization of mining will dislocate more miners than the inroads of atomic electric power.

MANPOWER COMPETITION EXPECTED TO INCREASE

New competition from nuclear energy for the presently inadequate supply of trained technical personnel will aggravate a situation which has already assumed serious, if not alarming, proportions. In a report by the Atomic Energy Committee of the Manufacturing Chemists' Association, it is estimated that 10 percent of the chemists and chemical engineers are now entering the nuclear field, and that this continuing demand will decrease those available for industry and teaching.

MORE FACILITIES FOR NUCLEAR ENERGY

Alco Products is building a reactor criticality facility at Schnectady at a cost of about $230,000. . . . General Electric Will establish headquarters in San Jose, Calif. for its Atomic Power Equipment Department, expected to employ more than 500 persons by the end of this year. . . . Power Reactor Development Company has been formed to carry out the atomic reactor power plant project proposed by Detroit Edison and a number of other firms last March. This group will carry on design, construction, and operation of a fast-neutron breeder reactor under the AEC's power demonstration reactor program.

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HOME OFFICE···OMAHA NEBRASKA

November 21, 1955

The North American Mogul Products Co.
Standard Building
Cleveland, Ohio

Re: Home Office Building
United Benefit Life Insurance Co.
Mutual Benefit Health & Accident Association

Gentlemen:

We have three 178 H.P. low pressure boilers that are used for heating our Home Office Building and our Cafeteria Building, a total floor space of 392,939 square feet.

We are using MOGUL M-16 in our boilers, with good results. The boilers and tubes are clean enough that we have not had to use the third boiler even in the coldest weather. We also use MOGUL MP-31 in our air conditioning system and our 1025 ton cooling towers with the best of results.

To insure optimum conditions and efficient operation, the equipment must be clean inside as well as outside.

Mogul is doing a nice job taking care of our equipment and we, in turn, are keeping our 2,861 employees comfortable and happy on the job.

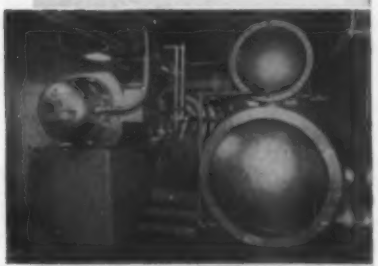
Sincerely,

Charles Gier

Charles Gier
Superintendent of Mechanical Engineering

CG/bjs

Mutual of Omaha — "the World's largest, exclusive Health and Accident Company"



725 Ton Centrifugal Refrigeration Unit.

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new products

. . . just circle key numbers on READ-N-CIRCLE card on page 67

700-Glass fiber glazing reduces breakage and maintenance

Glass-fiber reinforced plastic glazing material that reduces window breakage and maintenance problems to a minimum has been developed specially for industrial use. Structoglas glazing is shatterproof, weather resistant, and extremely lightweight (0.080 inches thick). It can be installed more quickly, easily, and safely than glass because its high impact strength eliminates need for careful handling. Has other outstanding inherent advantages —reduces glare and heat of direct sunlight without reducing interior lighting efficiency. Saves on heating and air-conditioning costs because of its superior insulating qualities. Bright but diffused natural daylight coming through these panels substantially improves working conditions and reduces accidents that result from poor visibility. Available in green, blue, or clear (translucent) color to meet individual requirements. Comes in standard sash sizes with an exclusive pebble-grain surface that helps eliminate outside distractions. STRUCTOGLAS DIVISION, INTERNATIONAL MOLDED PLASTICS, INC.

701-Gas engine ignition unit reduces maintenance costs

Ignition system for heavy-duty high-compression gas engines combines a new type magneto with transformer coil. Meets exacting requirements of large stationary industrial engines of 6 to 16 cylinders between 1000 and 4000 hp. System delivers more than ample voltage with minimum spark plug erosion. Adjustment of magneto master breaker is normally required only once a year. Magneto has high output at normal cranking speeds and does not require an impulse coupling for starting. Unit breaker assembly is easily adjusted, and operates with minimum wear because of low current at breaker points. Spark is advanced or retarded by rotating entire magneto section, either manually or through mechanical linkage. BENDIX AVIATION CORPORATION.

702-Lubricant additive for all-round industrial use

Low viscosity halogen cresyl compound retains its affinity to the point of frictional heat. Chemical reaction then takes place with sufficient force to form a cushion and prevent weldment. When two percent by volume is added to 160-viscosity cutting oil, load carrying capacity increases 43 percent. Coolant life increases 75 percent. Working efficiency of cutting oil increases 35 percent. When added to hydraulic oils, pump life increases by as much as 250 percent without any physical change in seals, gaskets, plastic hoses, and other nonmetallic components. Addition of one ounce to a gallon of oil in torque converter improves lubricity 35 percent. Effective at temperatures to — 100 F. Can be added to any lubricant. DESTINY PRODUCTS COMPANY.

703-Telescopic boom reaches inaccessible places

Boom that telescopes hydraulically with a full-capacity load is incorporated in the new model 60 Pitman Hydra-Lift, a 6400-pound capacity truck crane that requires only 40 inches of space behind the truck cab. Can be installed on any truck two tons or larger. With telescopic boom, loads can be positioned in spots which would be virtually impossible to reach with any standard boom. Boom telescopes from 17 to 27 feet. Hydraulically operated outriggers are controlled from two levers which can be reached from either inside or outside the cab. Full-capacity loads can be raised or lowered with either loadline or boom. Comes as a package unit to reduce installation time and cost. Hydraulic fluid is almost exclusively carried in seamless steel tubing to avoid hose replacement costs and increase safety. Will reduce drastically the labor force required on heavy lifting jobs. PITMAN MANUFACTURING COMPANY.

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Introducing...

A NEW TYPE OF CONTROL

For PRESSURES up to 250 lbs.

It's the

McDONNELL

Your Jobber Stocks Them

92 Series Pump Control, Low Water Cut-off and Alarm Switch

You are looking at the most advanced control of its type. It is a product of "Doing One Thing Well"—designed and developed by the organization that is the recognized leader in the manufacture of boiler water level controls and safety devices.

This 92 Series control handles three important jobs, singly or in combination:

1. Controls a boiler feed pump from the boiler water level—as it *should* be controlled to maintain maximum efficiency.
2. Provides a low water fuel cut-off, stopping the automatic burner in the event of an emergency low water condition.
3. Closes an electrical circuit when low water occurs—for operating an alarm.

To these jobs the 92 Series brings a new concept of design and operation, combined with time-honored quality and craftsmanship.

The No. 192 (shown above) is a water column type control with the necessary tappings for mounting the gauge glass and try cocks. **The No. 92** (at right) is used where an independent water column is installed.

This 92 Series makes McDonnell control available, not only for boilers, but also for many other industrial liquid level control applications with pressures up to 250 psi.

For full engineering information, write for copy of Bulletin No. L-119

McDONNELL & MILLER, Inc., 3500 N. Spaulding Ave., CHICAGO 18, ILL.

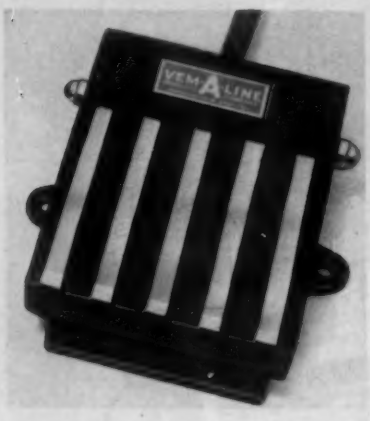
Doing One Thing Well

new products

. . . starts on page 10

704-Nonskid footswitch for rough usage

New footswitch is constructed of all cast aluminum with cast aluminum-ribbed top for nonskid operation. Will take greatest amount of



abuse without wear. Contact rating is 15 amperes, 125 volts ac single pole, double throw. Also available in double pole, double throw (10 amperes). VEMALINE PRODUCTS COMPANY.

706-Proximity relay solves control problems

Proximity of any movable material to stationary probe of a new proxim-

ity relay affects an electronic circuit controlling a power relay. Differentiates between materials for interface. Relay automatically activates solenoid valves, motor starters, or power relays. Level control requirements from a fraction of an inch to several feet can be met. EXCEL ELECTRIC SERVICE COMPANY.

708-Moly penetrating oil in aerosol dispenser

Penetrating oil for loosening frozen fittings, nuts, bolts, sheaves, and so forth now comes in a pressurized container. Can be carried in toolboxes without danger of spillage. High-pressure stream simplifies application in difficult positions—shoots four feet

in any direction. Loosening action is almost immediate. Molybdenum disulfide additive lubricates under extreme conditions. Will not squeeze out of threads or evaporate from hot surfaces. Particularly suitable for hot applications. PRESSURE PRODUCTS CO.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 67.

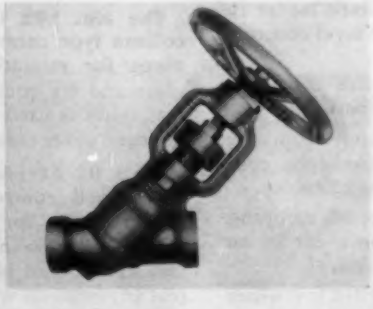
705-Female return bend is extra tight

Extremely tight return bend accommodates ¼- to 1-inch diameter tubes in steps of 1/8 inch with an optional cut depth of 3/16 to 1/4 inch. Center-to-center distance is 1/8 inch

greater than outside tube diameter the bend accommodates. Permits more tubes to be accommodated in a small opening than can be accomplished by regular bends for more efficient operation of all types of heat exchange equipment. GERRY TOOL COMPANY.

707-Compact valves for high pressure service

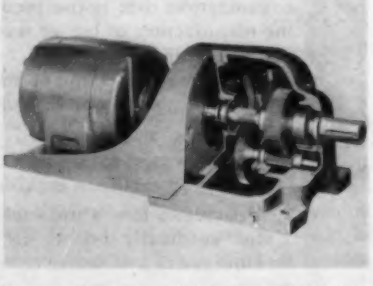
Valve for high-pressure, high-temperature service has an integral seat of heavy stellite that is welded on seat nozzle and finished before nozzle is welded to body. Annular groove



absorbs thermal changes near seat, prevents distortion during assembly, and permits a positive seal when valve is closed. All working parts are readily removed through yoke. Comes in seven sizes, from ½ through 2½ inches. Cuts maintenance drastically. YARNALL-WARING COMPANY.

709-Handle heavy shock loads without any downtime

Stamina without excessive bulk is most important feature of new line of Motogears. Straddle-mounted pinion gives rigidity to high-speed shaft and pinion. Double reduction types



have ratios from 6.2:1 through 38.4:1, and transmit up to 60 hp. Triple reduction types have ratios from 47.1:1 through 292:1, and transmit up to 20 hp. Cast housings give complete protection under most severe abuse. Motor mount withstands heavy loads without deflection. LINK-BELT COMPANY.

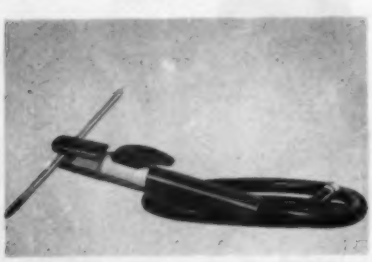
710-Black high-heat paint is elastic

Low-cost black high-heat paint gives maximum protection to surfaces subjected to temperatures up to 75 F. HSE Black is composed of a black pitch base bolstered with a special silicone additive. Forms a heavy-bodied

coating that does not blister or become brittle even when subjected to varied temperatures, smoke, fumes, mild industrial acids, alkalies, and moisture. Dries to a smooth finish in 8 to 10 hours, and does not require special baking. May be applied by either brush or spray without interrupting your firing operations. SPECO, INC.

711-Cutting and gouging torch for heavy duty

New cutting and gouging torch for heavy-duty work has impact-resistant molded jaw insulators for longer service life. Silicone glass laminate sleeve protects upper end of handle from heat. Will take up to 5/8-inch diameter electrodes. Operates from



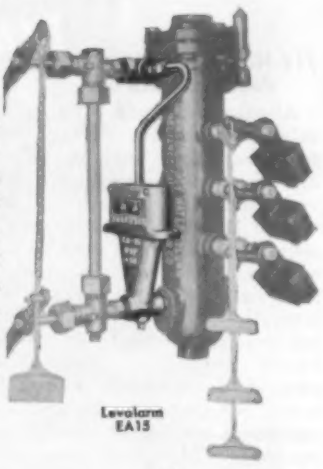
an ordinary dc welding machine and a compressed air line. Has a rotating nozzle that permits changing electrode angle to suit job, but always maintains air jet in perfect alignment. Air and current are brought to torch through a concentric cable to simplify handling. ARCAIR COMPANY.

Tiny currents guard boiler safety

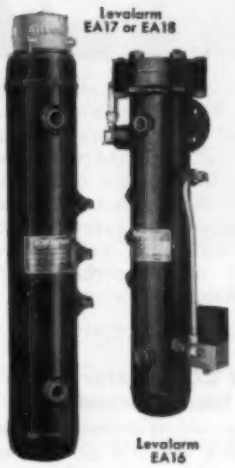
You can operate alarms, fuel cut-out, start and stop pumps safely and accurately with

Reliance Levalarms®

Now you can protect any boiler, from lowest pressures to 2500 psi, with a completely electrical fast-acting alarm system and other controls. Actuated by a tiny current — 25 milliamperes or less — relays pick up signals through the opening or closing of isolated electrode circuits installed on or in the boiler water column. Levalarms are unaffected by pressure, temperature or water conditions.



Levalarm EA15



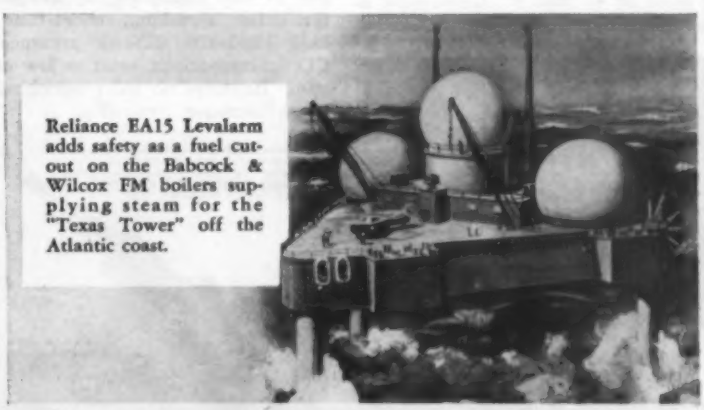
Levalarm EA17 or EA18

Levalarm EA16

Low alarm or high alarm or both, fuel cut-out, and starting and stopping of pumps thus are affected with the speed of electricity *within a small fraction of an inch* change of the boiler water level at predetermined safety points.

The simplest of four Levalarm models, shown above, is a fuel cut-out on a water column. Other variations are for higher pressures and wider variation of control combinations. For the full story about these new Levalarms, write for Bulletin D2.

The Reliance Gauge Column Company
5902 Carnegie Ave. Cleveland 3, Ohio



Reliance EA15 Levalarm adds safety as a fuel cut-out on the Babcock & Wilcox FM boilers supplying steam for the "Texas Tower" off the Atlantic coast.

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

Circle 116 on READ-N-CIRCLE CARD for more data

new products

. . . starts on page 10

712-Hot pipe paint does not burn off

Aluminum-silicone paint fights accelerated corrosion that is peculiar to engine exhaust stacks by not burning off under blasting heat. Alumicone withstands temperatures in excess of 1500 F. It is based on a silicone-alkyd resin and contains aluminum pigments. Where normal paint films have failed after a few hours time, Alumicone has remained in perfect condition after more than 400 hours' operation. Paint can be sprayed or brushed directly onto metal. No special primers or involved equipment are needed. Surface to be painted should be cold when paint is applied. Has exceptional durability for furnace doors and smokestacks. ATECH, INC.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 67.

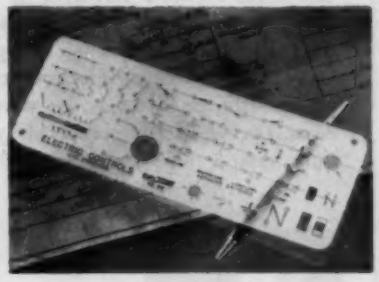
713-Spot check thermometer takes surface temperatures

New type of thermometer, made entirely of stainless steel, has a range of from 50 to 1000 F. Instrument is merely laid on surface to be checked.

Within 60 seconds it reaches stability so exact temperature can be read. Beside surface temperatures, it also reads ambient temperatures in enclosed spaces, such as ovens and furnaces. Useful for noncorrosive liquids and gases to 1000 F. Accurately calibrated to ± 2 percent, can be reset at any time if necessary. Small enough to carry in the pocket. PACIFIC TRANSDUCER CORP.

714-Drafting template has automation symbols

Drafting template, engraved with cutouts of all JIC electric controls and automation symbols, reduces layout and schematic diagraming time. For



use with pen or pencil, is also suitable for stylus and stencil work when multiple copies are required. Rigid, glareproof vinyl template measures 9 x 3⅜ x 0.030 inches. One of a series covering electronics, electric controls, control instruments, hydraulic circuits, air conditioning, cathode systems, and electro-mechanics. A. LAWRENCE KARP.

715-Pocket CO detector shows hazard instantly

Pencil-size carbon monoxide detector shows at a glance if gas is present in any concentration dangerous for either occasional, short-time, or long exposure. Shows presence of CO concentrations, even as low as 40 ppm. Requires no color matching or

REPLACEABLE INDICATING TUBE CONTAINS CARBON MONOXIDE SENSITIVE CHEMICAL WHICH TURNS BROWNISH-GRAY WHEN CO PASSES THROUGH TUBE
ASPIRATOR WITH CONNECTOR FOR HOLDING THE INDICATING TUBE

reference to a comparator scale. Yellow, sensitive chemical turns brownish-gray when CO passes through tube. Comes with 24 indicating tubes. BACHARACH INDUSTRIAL INSTRUMENT COMPANY.

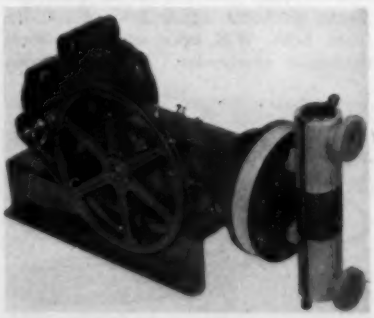
716-Fluorocarbon laminate bonds to any surface

Fluorocarbon plastic laminate with high-temperature and extreme chemical resistance can be adhesive-bonded to almost any contoured surface. Consists of a thin continuous layer of Kel-F plastic on glass cloth. Can be cut with a knife, and can be either cold or hot formed to flat surfaces or those with compound curvatures. Has high dielectric strength

and nontoxic and nonsticking characteristics. Very resistant to chemicals, abrasion, and temperatures to 400 F. Vessels ranging from rectangular plating tanks to complex reactors with flanged pipe connections and dished heads can be lined with this material. Comes in sheets 36 x 46 inches for easy handling. THE M. W. KELLOGG COMPANY.

717-Positive displacement pump for hot chemicals

Positive displacement pump is completely inert to all chemicals and solvents except molten alkali metals and fluorine at high temperatures and pressures. Pump is diaphragm type



with head, all valve components, connecting flanges, and nipples made of Teflon. Will run dry without harm. Has no packing glands or rotary seals to leak irritating or obnoxious fumes. Passes about 10 percent of capacity of vapor, gas, or air without losing its prime. O. K. MACHINE & TOOL, INC.

718-Tower packing increases throughput up to 3½ times

New tower packing material increases efficiency of distillation, absorption, scrubbing, and stripping. Has interlocking horizontal diamond-

shaped cells. Cells, with walls of special expanded metal, are placed adjacent to and over one another. Advantages are large capacity and effective contacting action down to 40 percent of design loading. Venturi openings cause maximum mixing at minimum permanent pressure loss. S. BLICKMAN, INC.

719-Precast stack comes insulated

Precast insulated stack comes in six sizes from 10-inch to 24-inch id. All-fuel refractory stack is for use with boilers, furnaces, ovens, retorts, and incinerators where flue gas tem-

peratures do not exceed 1600 F for continuous exposure. Cost is about 2/3 less than a comparable brick stack and about the same as a comparable steel stack. Gives greater draft and lasts about three times longer than steel. VAN-PACKER CORPORATION.

YOU CAN SAVE A COAT OF PAINT OR TWO WHEN BUILDING A NEW PLANT

Subox paints are based on suboxide of lead, a most effective anti-corrosive agent. They are the only paints made in America using this chemically-active, finely-dispersed pigment that spreads smoothly, evenly, thoroughly, adheres closely and endures for many years.

Very often two coats of Subox replace three coats of standard paints, and frequently, even one coat is sufficient, especially as Subox* and Subalox* come in many attractive colors and serve as primers as well as finishing coats, or can be applied over conventional primers.

For full information write for the brochure: *"Plan Painting of New Plants to Reduce Costs."*

Subox Inc.

Established 1924 *Trade Mark

9 Fairmont Plant, Hackensack, N. J.

See Catalogues in Sweet's Industrial and Engineering Files

Circle 108 on READ-N-CIRCLE card for more data

new products

. . . starts on page 10

720-Package vaporizer for broad temperature range

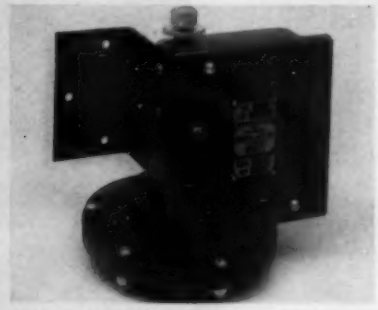
Package vaporizer for use with Dowtherm "A" or "E" Para-Cymene or Anisole provides accurately controlled temperatures over a broad range. Unlike steam generators, type MH vaporizers can be used to obtain extremely high temperatures at low pressure. Have a compact, three-drum design. Meet requirements from 3.7 million to 15 million Btu/hr. Burn oil, gas, waste heat, or special fuels with a slight positive pressure in furnace. Induced draft fans are eliminated and stack height is reduced. Union Iron Works.

721-Flame-resistant curtains are inexpensive

Flame-resistant impregnated canvas curtains and blankets protect against intense heat, arc flash, molten splash, and flying chips and scale. Made of UL approved asbestos cloth in sizes up to 100 sq ft. Grommets are one-foot apart. Eastern Equipment Co., Inc.

722-Vacuum static pressure control is supersensitive

Vacuum static pressure control outstanding for sensitivity and ease of adjusting is built for use on very low vacuums where regulation is required in inches of water. Particularly useful as an air vacuum interlock switch for equipment that requires specific vacuum to prevent hazardous conditions. Standard units available for 0 to 1-inch water column vacuum and 0 to 4-inch water column vacuum. Minimum on-off differentials of .01-inch water column are available. Electrical ratings of SPDT switch are 15 amperes at 120-250 volts ac, ⅛ hp or 125-volt ampere pilot duty. Special diaphragms give high sensitivity. The Henry G. Dietz Company.



723-Analyzer gives continuous readings

Portable instrument for measuring CO_2 in flue gas gives continuous readings so results of adjustments can be seen immediately. Uses a thermal conductivity analyzer cell. Self contained and easy to use. Useful for determining flue leaks. Thermco Laboratories.

724-Portable instrument measures combustibles

Portable precision instrument for measuring oxygen and combustibles in exhaust gases weighs only 35 pounds. Oxygen is measured by catalytic combustion, using a disposable propane container. Results are registered on a scale with two ranges — 0 to 5 percent and 0 to 21 percent. Combustibles are measured in a separate cell and are indicated on an individual meter, also with two ranges — 0 to 3 percent and 1 to 15 percent. Both can be read simultaneously. Lightweight aluminum carrying case measures only 18 x 12 x 18 inches. In-plant demonstrations are offered. Instrument Division, Davis Emergency Equipment Co. Inc.

725-Shop heater is also incinerator

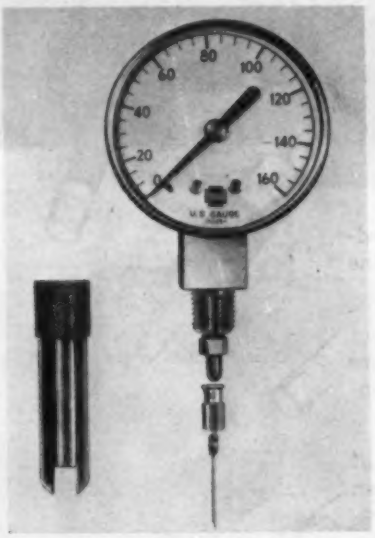
Incinerator-stove that is ideal for factories, warehouses, garages, and similar buildings will burn all kinds of rubbish. Rubbish fire supplies odorless, clean, free heat to surrounding area. Unit saves both heating and rubbish disposal bills. Made of cast iron and heavy steel plate, heater will last indefinitely. Large nonstoop feed door measures 30 x 14½ inches and can digest large cartons. Large firebox and ashpit can burn debris for a week without ash removal. Needs no permanent chimney. Hoskinson Industries.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on page 67.

726-Hypodermic pressure gauge for hoses

Pressure gauge for determining available air pressure at point of use is equipped with a BD-20 hypodermic needle and guard. The two-inch diameter gauge is finished in chrome.



Air hose can be tapped at point of use, thus determining pressure or number of branches on line. U. S. GAUGE DIVISION, AMERICAN MACHINE AND METALS, INC.

727-Dust collector moves to job

Powerful, portable, self-contained dust collecting system that uses any standard garbage or trash can as waste receptacle is ideal for on-the-job maintenance work. Collects dust

right at the machine. Can be used also for cleaning machines. Suction is created by a special eight-inch pressure-type blower. Dust is carried through a 2½-inch diameter hose. Air escapes through filter bag on top of machine. CRAFTOOLS, INC.

Your plant and equipment suffers . . . your community goodwill fades away. These problems can be solved. Prat-Daniel Collectors are designed for the control of industrial dusts and flyash. Multiple small diameter tubes provide powerful centrifugal forces, resulting in sustained high collection efficiency . . . even with ultra-fine dusts.

Whether the problem is industrial dust or flyash, you are assured of satisfaction with P-D Collector Systems, engineered to meet your specific needs.

Write for Reprint No. 102 titled, "What Type Collector?"

pd

Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)
Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Que.

Designers and Manufacturers
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.
POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

Circle 100 on READ-N-CIRCLE card for more data

"We prevented Field complaints and motor Burnouts — by protecting our sewing machine drive motors with FUSETRON FUSES."

"By 1949, increased sewing machine speed and stepped-up production tempo were putting an added burden on the drive motors we make for Singer Sewing Machine Co.

"It was necessary to find a more effective way to protect these industrial sewing machine motors — otherwise, we might expect increasing motor burnouts and field complaints.

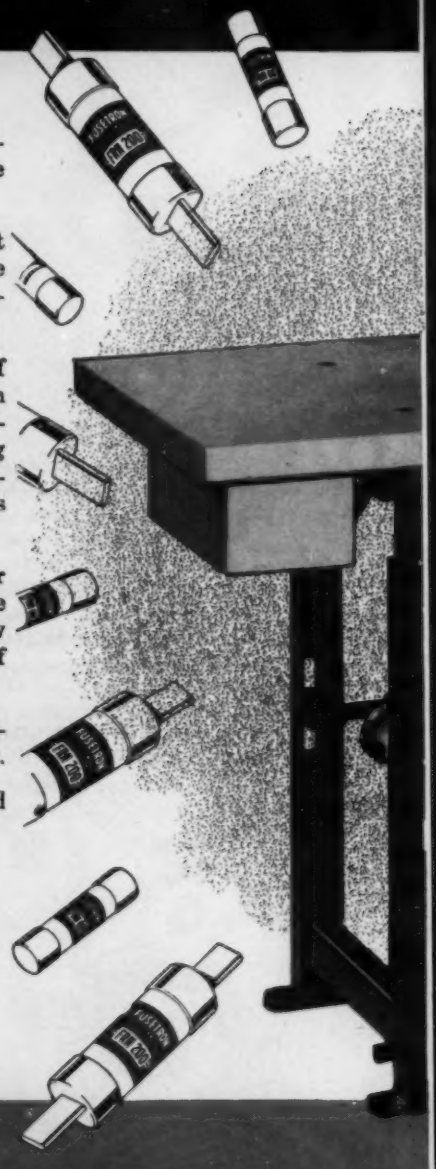
"An extensive test was conducted on the application of Fusetron dual-element fuses of motor-running protection sizes. Our investigation showed that Fusetron fuses, because of their time-lag, would hold the motor starting current. They also would absorb the current surges resulting from starting the sewing machines 40 or more times per minute.

"In addition, Fusetron fuses would safely take the motor off the line if the branch circuit was single phased. We were particularly interested in this finding because we knew this type of power supply fault could give us a lot of trouble.

"On the basis of our tests, we decided to provide individual Fusetron fuse protection as standard equipment.

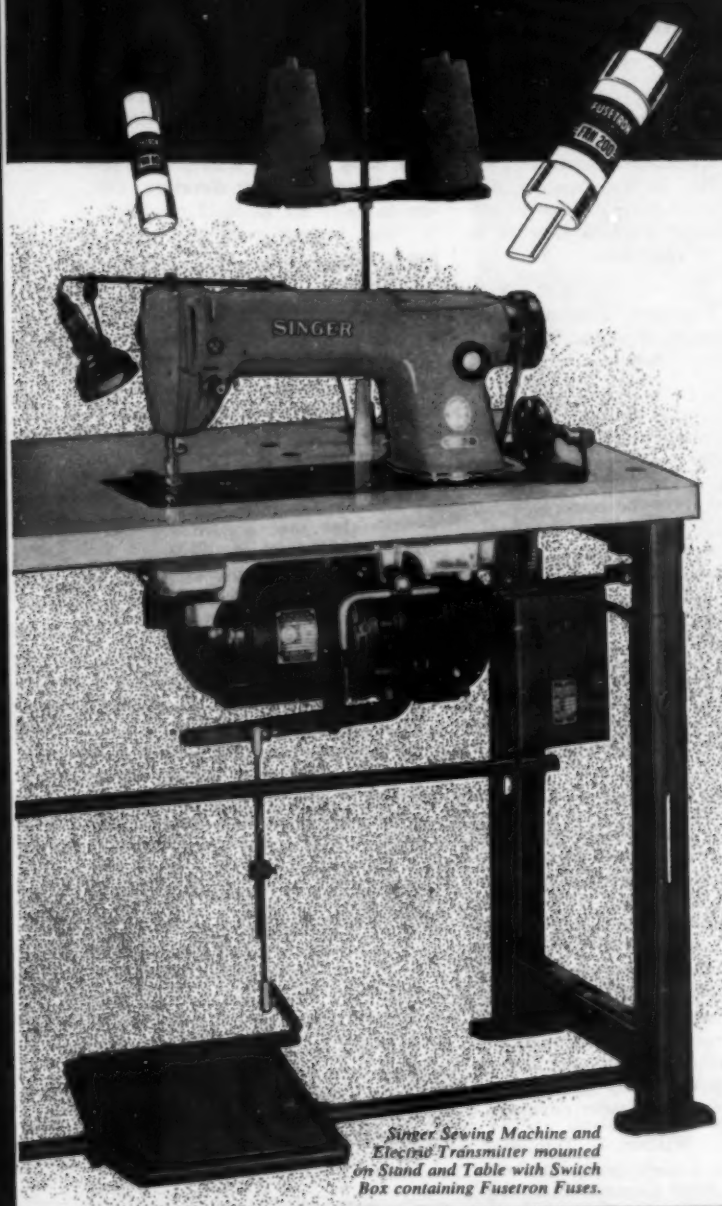
"As we expected, this decision practically eliminated motor burnouts and prevented field complaints."

R. D. Ingalls,
CHIEF ENGINEER
DIEHL Mfg. Co.
Electrical Division of
The Singer Manufacturing Co.
SOMERVILLE, N. J.



Play Safe! **install Fusetron Fuses and BUSS Hi-Cap Fuses throughout the entire Electrical System.**

You too, can eliminate Protection Troubles with FUSETRON FUSES . . . *They provide 10 point protection.*



Singer Sewing Machine and Electric Transmitter mounted on Stand and Table with Switch Box containing Fusetron Fuses.

1. High interrupt capacity — protect against heavy short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloads.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., . . . Use *BUSS Hi-Cap Fuses*

They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

On new construction, tell your architect to specify this Safer, Better Protection.

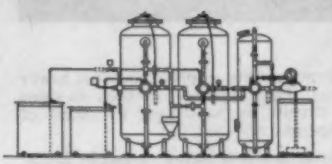
For detailed information on Fusetron dual-element fuses and BUSS Hi-Cap fuses, write for bulletin FIS and HCS.

BUSSMANN MFG. CO. (Division of McGraw Electric Co.)
UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Circle 109 on READ-N-CIRCLE card for more data

ILLCO-WAY
ionXchange

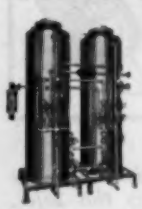


GET H_2O ONLY

In those processes where chemically-pure water is desired, the most economical way to obtain it is often by de-ionization. Current ionXchange practice provides an effluent which is chemically the equivalent of that obtained by multiple distillation.

ELIMINATE ALL DISSOLVED SOLIDS

Starting with water containing various dissolved solids such as calcium sulfate, magnesium carbonate, silica, etc., one form or another of ionXchange can be employed to eliminate ALL of these solids in the resultant purified water. *We have been designing and building practical equipment to accomplish such results ever since the enabling resins first became available.* Tell us your needs, and let us see what we can do . . .



ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
840 CEDAR ST.
ROCKFORD,
ILLINOIS
NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

Circle 140 on READ-N-CIRCLE card

our readers write

. . . to industry & power

Quality and diversification

Gentlemen:

Please furnish one copy each of the following feature article reprints as listed in the January issue. . . . We thank you for the fine quality and diversification of your articles in INDUSTRY & POWER. We look forward to the receipt of each issue.

J. B. Martz
Plant Engineering Department
International Business Machines
Endicott, New York

● *Reprints are on their way. We appreciate the comment about diversification. It is our fundamental belief that if there be one recurring failing among Power Services Engineers, it is their reluctance to recognize just how diversified their responsibilities in industry really are. We have written about this before, and will write about it again soon in "this month's comment."*

Electrical refresher reprints

Gentlemen:

I would . . . like to be put on your mailing list for reprints of your forthcoming "Electrical Refresher" as they become available. . . .

I would like to compliment you on the timely and interesting articles that have appeared in your magazine, and I have found some of them to be quite useful. Perhaps someday you might run a series similar in nature to your other Refresher Series on nuclear power, only giving it a more intensive and broader coverage.

William L. Tompkins
Process Engineer
Universal Atlas Cement Company
Gary, Indiana

● *All requests for reprints of our Electrical Refresher are being held until completion of the series. At that time, each request will be filled with a complete set of the articles comprising the Electrical Refresher. We will schedule future Refresher Series on topics of fundamental concern to Industry's Power Services—including nuclear power when it achieves the day-to-day importance of the already established Power Services. Though we are sure its day will ultimately arrive, we do not see nuclear power as a daily concern within the realm of Industry's Power Services.*

Fill in, please

Gentlemen:

I am employed at American Boxboard Company, Fiber City, Mich. as a turbine operator and read your magazine from the power superintendent's office. [I] derive much general information of interest to me [from INDUSTRY & POWER]. Now I would like to have you answer a question for me.

The question is: would ashes and soot intermixed as blown into the ashpit have any great amount of solidity when dry so as to be a load-bearing surface. With addition of some hard-fill or top cover, could this mixture serve as a coal dock?

An area is already being filled in at the lake shore. It could be outlined and extended in proper form and length with steel pilings. When allowed to fill in to a height of approximately 12 feet above water level, we could divert the material to a new ashpit.

An answer as to practicality of this would be appreciated.

R. Christiansen
Manistee, Mich.

● *Any readers have any experience to report that bears on Mr. Christiansen's question? Fill us in, please, and we will send your composite answer to Mr. Christiansen.*

Catalytic combustion popular

Gentlemen:

There appeared in the December 1955 issue of INDUSTRY & POWER magazine an article written by an engineer of the Reichold Chemical Company on the burning of tail gases in their Phthalic Anhydride Plant with a catalytic combustion unit. I do not know the name of this article.

Would it be possible to forward me a reprint on the subject matter?

R. C. Bacher
Chief Engineer
American Cyanamid Company
Bridgeville, Pa.

● *Title of our December article is "Fume Elimination May Be Only Half the Story." Reprint is on its way.*

Gentlemen:

We remember reading an article on a Catalytic Unit to be used in reclaiming heat from wasted gases. If this appeared in your magazine, and you can give us additional information on this unit, it will be very much appreciated.

John C. Porter
Power Engineer
Rock Hill Printing
& Finishing Company
Rock Hill, S. C.

● *Complete information about catalytic combustion units can be obtained from Catalytic Combustion Corporation, 4542 Grand River, Detroit 8, Mich. or from Oxy-Catalyst, Inc., Wayne, Pa.*

Pardon us

Gentlemen:

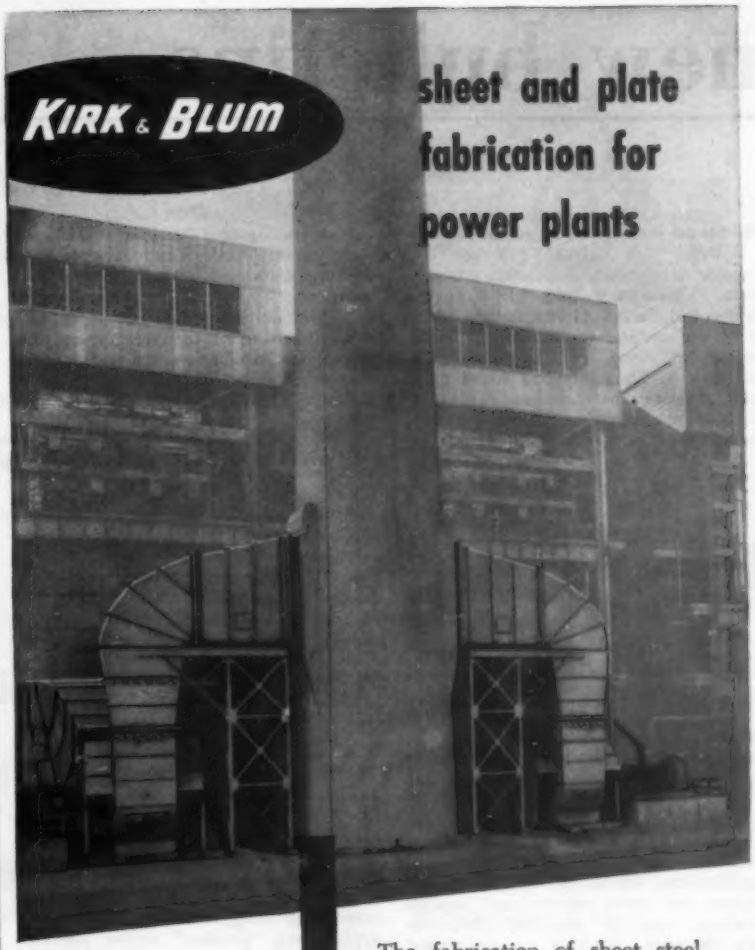
Page 53 of the December 1955 issue of INDUSTRY & POWER contains a quotation from a Bureau of Mines' Report of Investigations 5113. The word "quantity" in the original was changed to "quality" in your quotation, as you will note by comparing the wording on page 1 of the attached copy.

An increase of the "quality" of sediment may be variously interpreted.

A. A. Berk
Chief, Industrial Water Laboratory
Eastern Experiment Station
Bureau of Mines
College Park, Maryland

● *We apologize to all concerned for this error. That it was caught by a reader indicates to us that we cannot be too zealous in maintaining our standards.*

For the record, the sentence in question should read "Also, in some instances the quantity of sediment precipitated from [a fuel] oil was increased by a contribution from the additive."



- breechings
- stacks
- air & gas ducts
- casings
- louvers
- bins & hoppers
- insulation jacketing
- control panels & desks

The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for 50 years. Exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

Whatever your requirements in sheet and plate fabrication . . . call on KIRK & BLUM.

THE KIRK & BLUM MFG. CO.
3174 Forrer Street, Cincinnati 9, Ohio

Circle 106 on READ-N-CIRCLE card for more data

new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on page 67

400-Steam trap selector guide

Bulletin T-9 contains steam trap selector tables for 35 possible installations. Three-page fold-out diagram shows installation piping for 22 pieces of typical process equipment—with recommended steam trap and piping arrangements. Shows typical installations and gives recommendations for piping to obtain maximum steam trap efficiency. Twelve pages. YARNALL WARING COMPANY.

401-Deflection indicator bulletin

Magnetic-amplifier deflection indicator for equipment in which early detection of relative movement is desirable is described in Bulletin 05B8385. Indicator safeguards hydrostations, compressor and pumping stations, drive shafts, and other applications. Visual or audible alarm systems for both remote and nearby locations can be obtained. Requires only 60-cycle, 110-volt power source for operation. Eight pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

402-Strainer-air eliminator data

Strainers and air eliminators used with liquid meters are described in Bulletin OG-326. Discusses both in-line and angle models. Angle-type is made with center-to-face dimensions equal to standard 90-degree ell of corresponding pipe size. Features discussed are: replaceable valve faces and seats, resilient facing for main and pilot-valve assemblies, and toggle-type float arms. Eight pages. METER AND VALVE DIVISION, ROCKWELL MANUFACTURING COMPANY.

403-Get "bone dry" compressed air

Bulletin describes how ball-float trap eliminates all water and oil from compressed air system. Equipment is entirely mechanical and automatic. Requires no maintenance—has minimum of working moving parts. Also contains information on complete line of after-cooler-separator-filters. JAS. A. MURPHY & CO., INC.

404-Guide to planning bus duct

Latest concepts of bus enclosure for generator leads and switching stations are given in Bulletin 10004-A. Includes easy-to-understand guide of electric characteristics, ring size, working data, physical arrangement, and isometric installation layout. Gives recommendations for strength and simplicity for welded bus. Also includes typical examples for installation and maintenance economy. Eight pages. I-T-E CIRCUIT BREAKER COMPANY.

405-Treating small water supplies?

Bulletin 5570 provides answers to many questions faced by small industries in treating water. Presents in easy-to-understand form principal well water impurities with recommendations for their removal. Discusses economics of treatment facilities with attention being given to possible expansion. Considers use of sedimentation basins and steel gravity filters with standard chemical feeds. GENERAL FILTER COMPANY.

406-Versatile arc welder

Bulletin 1343 describes electric arc welder that gives four types of arc from one welder. Works on both ac and dc power. A versatile welder for general all-around welding, "Idealarc" is available in capacities up to 500 amperes ac and 450 amperes dc. Bulletin also contains guide for welding rod selection and correct operating current for 19 different applications. "Idealarc" welder operates from single-phase power lines. Gives soft or forceful arc. Eight pages. THE LINCOLN ELECTRIC COMPANY.

407-Transformer engineering data

Engineering manual on distribution transformers, Bulletin 136, contains performance data charts, dimensions, and weights for single-and three-phase transformers, both oil-and askaral-filled. Includes data on terminal details, arrangements, and testing and inspection practices. Sixteen pages. R. E. UPTEGRAFF MANUFACTURING COMPANY.

408-Communications speeded by air

Bulletin A-103-55 tells how airtube systems quickly transport paperwork throughout industry. Case histories are included of typical installations. Airtube terminals are illustrated to show how they fit into building design. Includes a section describing variety of carriers with diagrams of each carrier type. Fifty pages. LAMSON CORPORATION.

409-Steel conduit manual

Description and specifications of rigid conduit in sizes from ½- to 6-inch nominal id are included in Bulletin 18-255. Contains data on size, weight, and physical properties of five types of steel conduit. Data tables list the number of conductors for different AWG or MCM specifications that can be run in different conduit sizes. Also lists advantages of 19 percent easier bending and 14 percent easier wire pulling through conduit. Eighteen pages. GENERAL ELECTRIC COMPANY.

410-Air valves-cylinder data

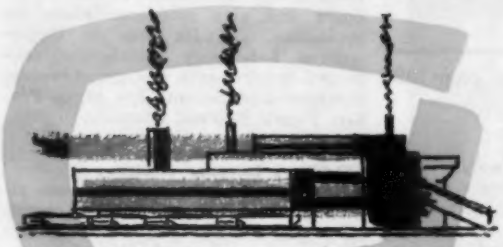
Complete line of single- and double-acting air cylinders, control valves, and accessories are described in this catalog. Includes dimension installation drawings of valve-in-head cylinders, dial feed tables, and a complete line of control valves. Price list is included for eight types in sizes from 1-1/8 to 4-inch bore. Thirty-eight pages. THE A. K. ALLEN CO.

411-Treat feedwater during use

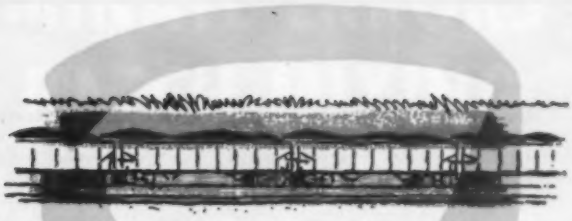
How treating boiler feedwater during operation can improve steam quality and reduce water maintenance costs is shown in Bulletin B1. Lists five benefits of Nalco direct boiler feedwater treatment. Also includes cost comparison of direct treatment and presoftening. Illustrations show typical boiler conditions after operation with Nalco treated water. Four pages. NATIONAL ALUMINATE CORPORATION.

412-Automatic valve manual

Solenoid controlled and panel mounted hydraulic valves are illustrated and described in Catalog 261. Features interchangeability of parts, greater flow capacity, less back pressure, and may be used as 3-way valve by plugging one cylinder port. Optional accessories are internal or external piloting, choke block,



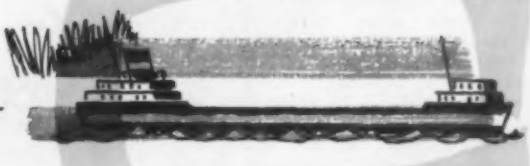
—engineered preparation



—by rail

from your own "back yard"....

—by riverways barges



—by deep water vessels

SOUTHERN brings you all the premium value, special purpose coals you need—23 million tons a year; ideally functional in variety at savings that lower power and heat costs. In this tremendous combined tonnage of Southern, Sinclair and Peabody Coal Companies there's coal to satisfy any quantity and burning requirement—coal from preferred seams and districts in your own bituminous-rich Mid-America.*

Obviously you save from Southern's low-cost, mechanized recovery, and with the clean, high BTU content and efficient burning performance assured by Southern's precisely engineered preparation.

But Southern gives you still another all-important saving—more favorable shipping rates from "close-to-home" supply sources—swift, direct by rail, by riverways barges and deep water vessels to all ports on the Great Lakes. Your nearby Southern representative will be glad to give you interesting figures.

*PREMIUM COALS FROM **27 BIG MINES** in Eastern Kentucky; Western Kentucky; Ohio; Indiana; northern, central and southern Illinois; Iowa; Oklahoma; Alabama and Missouri.

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OFFICES IN: LOUISVILLE, MEMPHIS, MINNEAPOLIS, NASHVILLE, ST. LOUIS
SINCLAIR COAL COMPANY, KANSAS CITY 5, MO., WESTERN REPRESENTATIVE

Circle 141 on READ-N-CIRCLE card for more data

new bulletins

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spool stroke adjustment, check valve, ac or dc voltage supply, and left-hand assembly. Eight pages. RIVETT LATHE & GRINDER, INC.

413-Steam generator specifications

Technical data, dimensional installation drawings, and illustrations of all basic components for water-tube steam generators are included in Bulletin 5511. Shows tube arrangement and gas flow for complete line of two-drum boilers with steam capacities of from 7500 to 40,000 lb/hr. Complete line of accessories includes burners, controls, safety equipment, and forced draft fan. Fourteen pages. THE TITUSVILLE IRON WORKS CO.

414-Bronze solder-end valves

Solder-end globe, gate, and check valves are described in this circular. Valves are suited for offices, warehouses, and industrial buildings. Includes recommendations for use in steam, hot and cold water lines, heating and air-conditioning systems, oil, natural gas, and underground water lines. Seats permit repacking under pressure. THE LUNKENHEIMER COMPANY.

When you need a compact, portable, electrically operated source of...
HIGH or LOW Pressure STEAM
HOT SHOT T.M.
SUSSMAN
ELECTRIC STEAM GENERATORS
are available in all sizes—for every conceivable purpose!
Used by the leaders of industry throughout the world—Since 1917
Ask your supplier, or write direct stating your needs—
AUTOMATIC
SUSSMAN
STEAM PRODUCTS CORP.
'40 West 31st St., New York 1, N. Y. BR. 9-9736

415-Crane electrification is easy

How inverted-wye conductors supply power in crane conductor systems is explained in Bulletin 2021-A. Contains dimension drawings for installation on I-beams, channels, and angles. Gives details on conductor assembly with data on conductors from 300 to 1000 amperes. Eight pages. THE CLEVELAND CRANE & ENGINEERING CO.

416-Save those irreplacable eyes

Complete line of plastic eye-protective equipment for every industrial use is described in Bulletin 200. Advantages such as optically perfect lenses, easy lens replacement, resistance to impact, and easily adjustable frames are discussed. Tables show resistance to light and to chemical reaction. Twelve pages. WATCHEMOKET OPTICAL CO., INC.

417-Rotameter selection guide

Full ranges, maximum operating pressure and temperature, and typical installations for every flow meter application are contained in Bulletin 120. Provides practical, versatile measurement where constant low rate-of-flow of liquids or gases is encountered. Recommendations for measurement of liquid level, specific gravity, orifice purging, and instrument purging are included. Eight pages. BROOKS ROTAMETER COMPANY.

418-Rugged V-8 for industry

Oversquare V-8 industrial engine built to operate on gasoline, natural gas, or LP gas is discussed in this bulletin. Full five-bearing crankshaft, overhead valves, wet cylinder sleeves, slanting-valve combustion chamber, water-cooled exhaust manifold, gear-driven water pumps, full-flow oil filters, and pressure lubrication throughout are salient features of this engine. Includes specific engine applications and specifications for optional equipment. Eight pages. LE ROI DIVISION, WESTINGHOUSE AIR BRAKE COMPANY.

419-Panelboard engineering data

Engineering data for panelboard selection and installation are contained in Bulletin 3-205. Illustrations, engineering drawings, and specifications describe the features and construction of each panelboard and give recommendations for application. Includes data on Underwriters' Laboratory transformer connection requirements, and circuit breaker characteristics. Seventy-five pages. FEDERAL PACIFIC ELECTRIC COMPANY.

420-Filters increase efficiency

How industrial filters can increase efficiency in water treatment or in chemical processes is discussed in Bulletin 111-112. Describes tailormade filters for maximum performance in a given job. Lists 30 applications for industrial filters with illustrations showing cleanout doors, quick-opening covers, jacketed shells, and rapid-cleaning features. Also describes two basic models, with installation recommendations. Eight pages. INDUSTRIAL FILTER & PUMP MFG. CO.

421-Temperature conversion chart

Handy two-color chart converts degrees Fahrenheit to degrees Centigrade over the range from −400 to +4000 degrees. It also shows temperature ranges of different sensing elements. Thermocouples, resistance bulbs, and radiation heads are shown, with recommendations for installation and maximum limits for both continuous and intermittent service. A valuable reference chart for all engineers. THERMO ELECTRIC CO., INC.

422-Measure level in closed tank

How to accurately measure liquid level in closed tanks under pressure is described in Bulletin 13-22. Instrument measures liquid level in tanks under pressure using a mechanism to balance out the effect of hydrostatic pressure in the piping line. Recommendations for suggested installations, complete specifications, and dimensions are given. Eight pages. THE FOXBORO COMPANY.

423-Pocket-size corrosion data

Unique, pocket-size folder describes 11 scale and corrosion control compounds. Contains recommendations for usage, including correct proportions. Compounds are available for scale and corrosion control, oxygen removal, pH adjustment, algae control, and for all problems encountered in water control. D. W. HAERING & CO., INC.

424-Cable raceway for every job

Raceways for cable and conduit for all installation problems are discussed in this bulletin. Globetray can be cut to any length and quickly installed. Complete set of standard fittings is available to permit change of direction or elevation. Horizontal elbows, inside and outside vertical elbows, tees, crosses, covers, and special fastening devices save installation time and labor. Load data is given for typical installations. Eight pages. THE GLOBE COMPANY.

425-Barometric condenser bulletin

Disc-flow and ejector-jet condensers suitable for any barometric steam condenser application are described in Bul-

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letin 9012-A. Condensers are made in sizes up to 10 feet in diameter and will handle up to 12,000 gpm of cooling water. Typical installations of both types of condensers are shown. Also includes complete analysis of the flow diagram, giving advantages and recommendations for installation. Eight pages. INGERSOLL-RAND.

426-High-efficiency pumps

When you buy a pump you look for high efficiency, mechanical dependability, durability, low power consumption, and low maintenance. Type M pumps for medium- and high-head service give you all five advantages. Double suction pumps have cases that are split on the horizontal center line with pipe connections in the lower half of the case. All rotating parts can be removed without disturbing pipe connections or alignment. Catalog A-155 gives construction details of both bottom suction and side suction types. Eight pages. C. H. WHEELER MANUFACTURING COMPANY.

427-Electric brake bulletin

Technical Bulletin C-11 describes features and operating characteristics of Series E electric brake. Cutaway and exploded views show rugged, compact, dependable operating characteristics. Contains dimension and rating table for the complete line of electric brakes. Eight pages. STAR-KIMBLE MOTOR DIVISION, MIEHLE PRINTING PRESS & MFG. CO.

428-Timber is a versatile builder

Versatility of timber as an engineering material for commercial and industrial structures is discussed in "Specify Timber." Discusses advantages and flexibility of new connector system to incorporate economy, maximum strength, durability, and utility. Contains illustrations showing roof trusses spanning more than 250 feet. Twenty-four pages. TIMBER ENGINEERING COMPANY.

429-Small pressure switch is mighty

Maintain sensitive static pressure control with miniature low-pressure switch, as described in Catalog 115. Contains recommendations for use in package steam boilers, air conditioning equipment, and other limited-space installations. HENRY G. DIETZ COMPANY.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 67.

430-Standby power with diesels

Emergency standby power applications using diesel and dual-fuel engines are described in Bulletin 125. Contains data on continuous and emergency output ratings for engines and power units from

ELIMINATE ERRORS in BATCH MIXING

with

NIAGARA *Automatic Displacement Meters!*

SET FOR 175 gallons—GET 175 gallons

Uniformity of a liquid product depends on accurate measurement of all ingredients from batch to batch. You can be sure of consistent accuracy by equipping with Niagara Electri-contact Meters. A precision electric Switch closes or opens an electric circuit after the passage of a predetermined quantity of liquid through the meter. Can also be used to generate electrical impulses to actuate other control mechanisms . . . shut off a pump motor . . . signal visually or audibly to the operator. Brings automation to liquid control and measurement in hazardous or non-hazardous atmospheres.

Chemical Meter with inclined register.

Rear View, Explosion Proof Meter.

Begin now to lower your liquid measuring costs and have the assurance of positive accuracy. Mail coupon for complete information.

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2933 MAIN STREET

BUFFALO 14, NEW YORK

Please send me complete information on the use of economical NIAGARA METERS, based on the data below:

Liquid..... Pressure.....p.s.i.

Temp.....°F.

Flow rate.....g.p.m.

Maximum batch.....gals.

Name.....

Company.....

Address.....

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new bulletins

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90 to 264 hp, and generator sets from 60 to 165 kw. Six pages. MURPHY DIESEL COMPANY.

431-Fuses for every purpose

Fuses for every purpose are illustrated and described in Folder 3. Also discusses Econ dual-element cartridge fuses for time-lag to protect against overloads and Economy delay renewable fuses and renewable links. ECONOMY FUSE & MFG. CO.

432-Alloy heat exchanger tubes

Cupro-nickel or nickel-copper alloys for condenser tubes, evaporator tubes, and feedwater-heater tubes are discussed in this bulletin. Describes, in narrative form, how alloy tubes have solved corrosion problems in numerous evaporator, condenser, and feedwater heater installations. Shows construction details of many well-known installations. Thirty pages. THE INTERNATIONAL NICKEL COMPANY, INC.

433-Ready power for emergencies

Dependable electric generating plants for alternating and direct current, operating on gasoline, natural or LP gas, or diesel fuel, are described in Bulletin 279-2. Lists safety devices including high water temperature and low oil pressure shutoffs. Complete line of equipment includes sizes from 1 to 100 kw. Includes data on air-cooled models in sizes from 750 to 3500 watts. Twelve pages. THE READY-POWER CO.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 67.

434-Get automatic fire protection

Details of engineered fire protection for hazardous conditions are described in Catalog 73. Discusses economics and gives recommendations for installation of commonly used "fire fog", airfoam, CO_2 systems and dry chemicals. Includes data in tabular form giving advantages and disadvantages of each system in extinguishing fires originating in various materials and areas. A welcome addition to the library of all power services' engineers. Twenty-eight pages. "AUTOMATIC" SPRINKLER CORPORATION OF AMERICA.

435-All you need for fluid power

Complete line of fluid power equipment is described in Bulletin 10051-D. Covers variable- and constant- delivery pumps, constant displacement reversible motors, variable-speed transmissions, duplex pumps, variable-delivery feed pumps, cylinders, valves, and auxiliary equipment. Complete data is given in each instance. Twelve pages. THE OILGEAR COMPANY.

436-Speed reducer hp rating data

Here is a comprehensive, well-illustrated booklet that contains full information about a complete line of speed reducers. Includes horsepower rating tables, specifications, dimensions, and other data needed for quick selection of speed reducers for various applications. Fifty-two pages. FARREL-BIRMINGHAM COMPANY, INC.

437-Mobile cranes are versatile

Operating data, capacities, and specifications of new six-ton self-propelled materials handling crane is contained in Bulletin CR-501. Describes features such as one-man operation, two-speed independent travel, and no-shift, forward-reverse travel. Contains capacity ratings of crane with various boom lengths and elevations. Four pages. SCHIELD BANTAM COMPANY.

438-How to lubricate turbines

How centralized lubrication has solved costly maintenance problems for turbine installations is explained in this bulletin. Describes a simple, dependable, foolproof, centralized lubrication system to eliminate turbine downtime. System will even lubricate bearings under water. Includes six case histories showing how centralized lubrication has saved money. Eight pages. THE FARVAL CORPORATION.

439-You won't regret using PVC

PVC rigid-type unplasticized pipe defies attack by industrial chemicals such as salt solutions, acids, alkalies, sulfates, caustic solutions, and bleaches. Imparts no odors or taste, has low flow resistance, resists weathering, and is lightweight. Easy to assemble and install. Extruded in standard pipe sizes from ½ inch through 8 inches in Schedule 40 and 80 weights. Costs less than stainless steel. Bulletin 80-3 gives engineering data and lists over 200 chemicals that can be safely conveyed in this wonder pipe. Eight pages. JOSEPH T. RYERSON & SON, INC.

440-Quieter hot air fans

Complete details and performance tables covering all circumstances in which many sizes and types of these high efficiency, low noise level industrial fans can be used are given in Bulletin C-102. Designed to fill any requirement for a Class I or Class II fan, this line of centrifugal fans is particularly suitable for handling hot air and gases up to 600 F. Basic types are identified by backward or forward curving blades. CHICAGO BLOWER CORPORATION.

441-How to use expansion joints

This expansion joint design guide, which is filled with engineering application and selection data necessary to proper solution of pipeline expansion problems, shows schematic piping layout. Catalog 153 discusses various types of expansion joints on the market and includes a simplified selection chart. A welcome addition to any piping engineer's library. Twenty-four pages. FLEXONICS CORPORATION.

442-Rotary air pump manual

Installation dimensions, capacities, and performance curves on complete line of rotary air and vacuum pumps are contained in Bulletin 755. Gives complete data on 2- and 4-wing types; double-cylinder, integral pump and motor air motors; and line of accessories. Twelve pages. LEIMAN BROS., INC.

443-Industrial fan selection data

Complete line of industrial fans for air, material, and long shavings handling are described in Bulletin 5306-H. This 11-section, well-illustrated bulletin contains tables and examples for fan selection. Also includes packaged fans and installation dimensions for all types and models. Information in this bulletin makes it a necessary addition to the library of any engineer. Seventy-two pages. AMERICAN BLOWER CORPORATION.

444-Gearmotor selection manual

How to select the right Gearmotor or Motogear is explained in detail in Bulletin 2447. Gives solution to two typical

installation problems. Includes 12 pages of selection charts and dimensions for complete line of Gearmotors and Motogears for class I, II, and III installations. Describes Gearmotors with capacities from 1 to 30 hp and Motogears with capacities from 1 to 60 hp. Recommended bulletin for the library of all power services' engineers. Twenty-eight pages. LINK-BELT COMPANY.

445-Hydraulic system chart

"Trouble-shooting Chart for Hydraulic Systems" is designed for display in shops. This chart will help operators and maintenance men spot and cure common troubles. Discusses such troubles as noisy pumps, leakage, overheating, and erratic action. Includes time-proven recommendations to cure most common troubles. SUN OIL COMPANY.

446-Pump maintenance hints

Helpful hints on maintaining initial pump efficiency and choosing dredge pumps to best fit your need are discussed in Bulletin 184-A. Describes 24 models ranging from 6- to 20-inch size. Text and illustrations cover both "GA" and "GAF" dredge pumps. MORRIS MACHINE WORKS.

447-Package plug-in busway

Construction and application of plug-in busway systems for feeding lighting and power loads in industrial plants is described in Bulletin GEA-6470. Shows how factory-assembled plug-in busway system permits direct connection to bus bars. Also lists ratings, weights, dimensions, installation data, and guide form specifications. Twenty pages. GENERAL ELECTRIC COMPANY.

448-Movable walls control space

Construction information on flexible interiors for offices, factories, and municipal and industrial buildings are included in Catalog 56. Lists advantages of flexibility, economy, fire-resistant construction, and ease of maintenance. Contains information on entire line of accessories and hardware. Movable interiors provide maximum efficiency in use of space. Sixty-eight pages. THE MILLS COMPANY.

449-Computer for your operation

Bulletin 4004A tells how you can have the services of fast, convenient network analyzers to study load flow, voltage, and short-circuit problems in your electric distribution system. Advantage is that system data you already have can probably be fed directly into analyzer. Gives all details including fees. Eight pages. I-T-E CIRCUIT BREAKER COMPANY.

450-Metering high-pressure fluids?

Engineering data and complete description on all three types of high-pressure meters: positive displacement; double-case; and Duo-Rotor, are contained in Bulletin 571. Describes construction features and gives recommendations for meters in sizes from 1½ to 8 inches and with capacities from 60 gpm to 30,000 gpm. Meters will withstand working pressures up to 1000 psi. Also includes dimension drawings and pressure-drop curves for all models. Eight pages. GRANBERG CORPORATION.

451-Insulating castable data

Bulletin 220 contains data tables for recommended use, permanent linear change at 212, 1200, 1750, and 2200 F, and modulus of rupture at these temperatures. Also gives thermal conductivity chart. FRANCE REFRACTORIES CO.

452-All-purpose evaporators

Straight tube and U-tube shell-type evaporators for boiler make-up water are described in Bulletin 10-DE. Lists design and operating features for boiler plants where distilled water is required. SCHUTTE AND KOERTING COMPANY.

Circle 103 on READ-N-CIRCLE card for more data

ideas in action

. . . for industry & power

Retractable curtains stop drafts

Low-cost, retractable TransWall curtains at Ford Motor Company's St. Paul, Minn. plant protect workers from cold drafts at exits. No costly air locks or heating devices are needed. Curtains are retracted during warm

weather to free use of floor space. Curtains, made by Bemis Bro. Bag Co., are built of heavily coated fabric. Nylon rollers facilitate retraction. Curtains 20 feet wide retract to only 2 feet.

Fast speed changes for blast furnace blower

Speed range of new blast furnace blower is 2600 to 3700 rpm, with speed changes from one extreme to the other possible in as little as 30 seconds. New, tiny turbine-driven centrifugal air blower is manufactured by

Allis-Chalmers. It replaces an enormous, space-consuming reciprocating engine-driven unit which had been in use since 1907 at Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corporation's Buffalo mill. Blower is driven by a 6020-hp Worthington turbine. Turbine is of stiff shaft design with first critical speed well above maximum operating speed of 3725 rpm. It incorporates a Woodward oil relay governor with integral air head. This device regulates steam flow through individually cam-operated multiple governor valves and gives best possible control of the wide speed range required for blast furnace blowers. Blower, only 7 feet high and 24 feet long, replaces a gigantic steam-driven reciprocating compressor that extended from basement to an approximate height of a five-story building and used a 24-foot flywheel. Turbine controls were designed and installed by The Hagan Corporation.

Tiny sub has tiny air conditioner

US Navy's new midget submarine X-1 is completely air conditioned, using cooling equipment by Carrier Corporation. New submarine weighs 25 tons, is 50 feet in length, has a maximum diameter of 7 feet, and is manned by 4 men. Air-conditioning apparatus is sized to match.

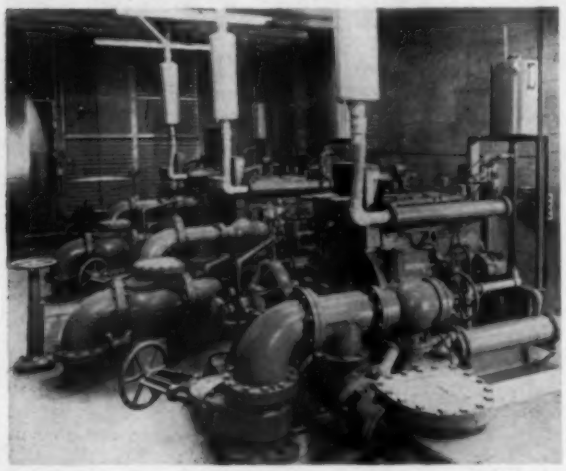
It occupies only a little more space than would be required for a 50-gallon oil drum. Cooling and heating coils, made with copper fins and tubes as a precaution against corrosion, are installed directly in ducts. System generates cooling equivalent to melting a ton of ice every 24 hours.

Interlocking water systems protect jet plant

Two identical, interlocking water supply systems protect US Air Force plant at Palmdale, Calif., against fire. Both systems are supplied by six Fairbanks-Morse pumps, which can deliver a maximum of 12,000 gpm at a discharge pressure of 100 psi. Size and dispersion of facilities were complicating factors in designing an adequate fire protection system. Because of the extreme fire hazard involved in final assembly and testing jet aircraft, deluge sprinkler systems were a necessity in all hangers. Water demands were very high. To provide alternate sources of water supply, yet avoid heavy expense of a complete water main loop around the 5000 acre site

Pereira & Luckman devised a system using separate pumping plants in each of two major industrial areas, joined by two miles of 20-inch main. A solenoid-operated hydraulic valve in this interconnecting line conserves water for the deluge sprinkler demand and keeps each area independent except in emergency.

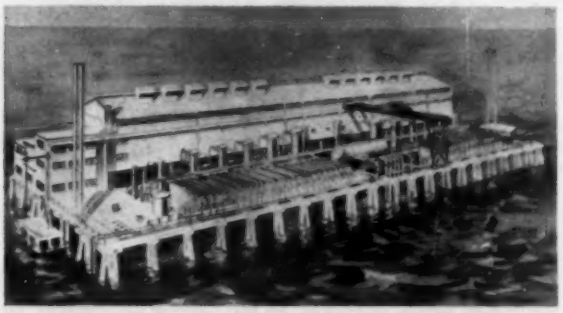
Two 24-inch diameter, 600-foot wells and two 450,000-gallon prestressed concrete reservoirs insure ample water supply to each station. Water is drawn from each of two wells by a 9-stage, 12-inch Fairbanks-Morse vertical turbine pump with a capacity of 750 gpm



at 385 feet tdh. Both pumps are powered by 100-hp, 1750-rpm, vertical, hollow-shaft F-M motors. One pump has an alternate drive—a butane engine operating through a Centric freewheeling coupling in place of a clutch. In event of electric failure, automatic controls, models, made by Custom Built Controls, start the engine. This second pump, with its dual power supply, is prime source of fire fighting water throughout the entire area.

Gas turbines pump gas

Most powerful concentration of gas turbines in the world will pump 300 million cu ft of gas back into the earth daily. Built by Westinghouse Electric Corporation, twelve 8000-hp combustion gas turbines with a total maximum rating of 96,000 hp will be installed on a plat-



form seven miles out on Lake Maracaibo, Venezuela. They will drive centrifugal compressors which will inject natural gas, derived from oil operations, under high pressure into the oil field that is under the lake and the surrounding area. This gas conservation plant will re-

MERCURY-TO-MERCURY SWITCH
requires no service—contacts never pit, burn or corrode.
PERMANENT ALNICO MAGNET
links water level with electrical controls; prevents failure of mechanical linkages.
CORROSION-RESISTANT FLOAT
is made of 304 Stainless Steel for long, trouble-free service. Can also be made of special materials for exterme local conditions.
NO-SCALE FLOAT CHAMBER LINER
"flexes" off scale; prevents float "sticking".
A magnetic sleeve, raised and lowered within a nonmagnetic tube, attracts or repels an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

Here's "Low Maintenance"

BOILER SAFETY

MAGNETROL

BOILER WATER LEVEL CONTROLS

"Blow-down" the float chamber once-a-shift; inspect the switches once a month—that's all you have to do to keep a Magnetrol in tip-top *safe shape.* It's made that way. The secret is all in the simple magnetic operating principle *as pioneered and perfected by Magnetrol.*

Standard Magnetrol Units are available for pressures to 600 psi and temperatures to 750°F., for single or multi-stage control with as many as three separate switching actions. Also special units for more extreme requirements. For full details, mail coupon.

MAGNETROL, Inc.

MAGNETROL, INC., 2130 S. Marshall Blvd., Chicago 23, Ill.
Please send Catalog Section III with full information about Magnetrol Boiler Water Level Controls.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Circle 117 on READ-N-CIRCLE card for more data

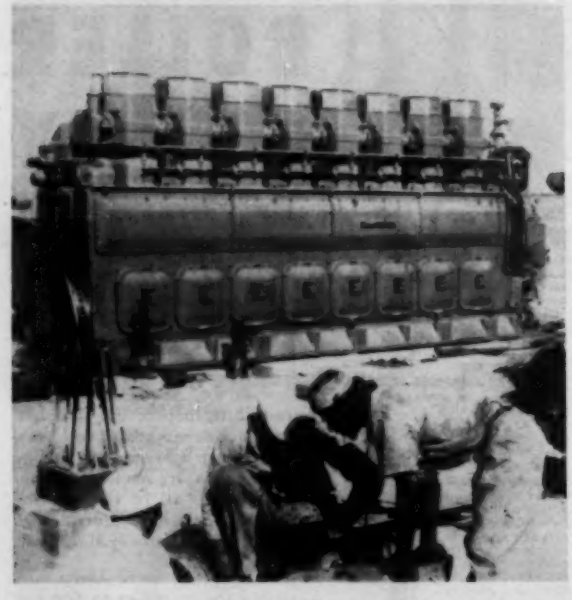
ideas in action

. . . starts on page 28

cover substantial quantities of additional petroleum and conserve large quantities of gas. Eight of the units will be direct connected to the centrifugal compressor and four will be geared. Turbines will operate in two strings of six units each. They will stand on a platform 440 feet long and 131 feet wide mounted on concrete piling in 80 feet of water.

Desert diesels operate without walls

Two Enterprise Engine & Machinery Co. diesels were operated in the open desert of Saudi Arabia for five months with only a roof for protection. Engines, rated 1560 bhp at 360 rpm, drive two Elliott 1375-kva generators that supply power for Nasreih Palace. Biggest hazard encountered while engines were out in open were characteristic Arabian windstorms. Fine desert sand invaded every opening, corner, and pocket. Constant clean up was necessary.



When inspected after 5500 hours operation at 90- to 110-percent full load, first unit showed negligible cylinder wear and about 0.002-inch wear off top piston ring.

Moisture resistant concrete is self insulating

New kind of concrete can be made with universally available materials such as ordinary sand and cement. All that is needed is a foaming agent compound and a water-soluble plastic agent, marketed under the name of Elastizell. When mixed with wet concrete in a special mixer, result is a homogeneous cellular or bubble structure that is light in weight because of the introduction of a high volume of air. Plastic agent gives the cells or bubbles a coating of high tensile strength. Homogeneous structure reduces possibility of cracking due to varying densities and strengths throughout the mass. Density and physical characteristics are controlled by the mixing cycle time and rotational speed of mixer. Exceptional

moisture resistance is due to close control over the size of bubbles in the cellular structures, to uniformity of concrete, and to moisture resistance of the chemicals. Moisture-absorption factor is only two percent by weight, and with the usual filled depth of 2½ inches, it saves 15 pounds weight per square foot over ordinary concrete. More than 50 million square feet have been installed in Europe within the last five years.

Vertical spotting for boxcars

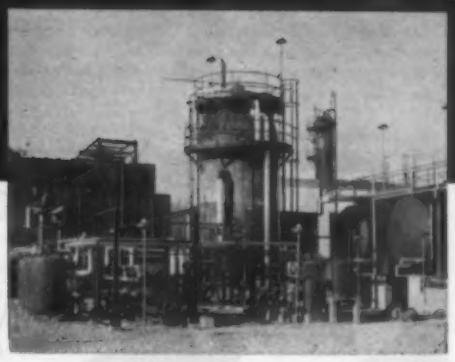
Unusual hydraulic elevator at the Humko Company of Memphis, Tenn., is capable of lifting a section of railroad tracks, including fully loaded railroad boxcar, to the second floor. Platform, which is 12 x 60 feet, can be elevated flush with the second floor, or it can be stopped with the boxcar door flush with the floor. Driveways are arranged so that even trailer trucks can be driven onto the floor. System was developed because horizontal expansion was

impossible and entire ground floor was needed for manufacturing processes. Elevator pit was built on a railroad spur that passed through the building. Platform has 60 feet of standard gauge railroad track built in and weighs 65,000 pounds. Net load capacity is 120,000 pounds when load is centered. Hydraulic power is provided by two Worthington rotary gear pumps, each driven by a 40-hp

(more ideas in action on page 64)

problems in water-conditioning . . .

VERSATILITY



SPENCER CHEMICAL COMPANY INSTALLS COCHRANE HOT LIME ZEOLITE

Photograph shows Cochrane Hot Lime Zeolite Softener installed in the new multi-million dollar Spencer Chemical Company plant, at Vicksburg, Miss. Capacity of the unit is 14,000 gph.

Cochrane—*pioneer in*

the versatile Hot Process

today leads in Hot Lime Zeolite

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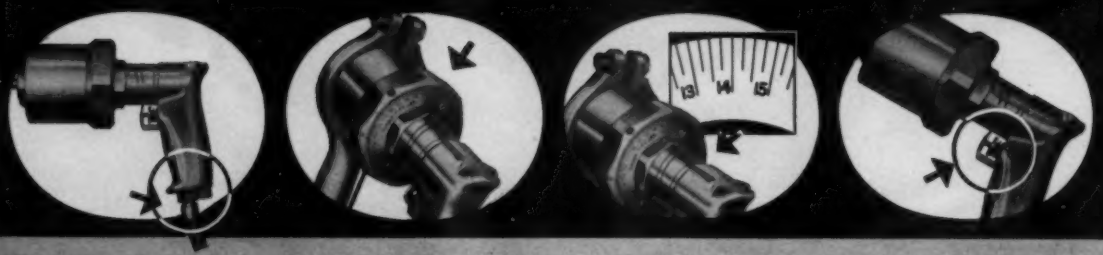
New WILSON Torq-Air-Matic

First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel.

Look at these exclusive design features of the WILSON Torq-Air-Matic

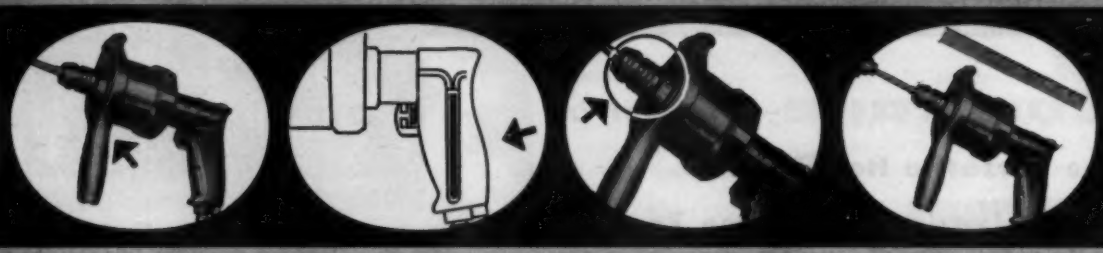


AIR-DRIVEN—Only air-driven tube expander drive with a built-in torque control. *Does not require a separate control box, relays or switches.* No extra cables or wires; just one small air hose serves it.

CALIBRATION—The only tube expander control calibrated *in terms of foot pounds torque instead of meaningless arbitrary units.* Torque requirements for expanding tubes of off-standard jobs can be more readily arrived at.

POWERFUL—Rated to deliver *fourteen foot pounds torque* at 90 psi. This is sufficient to roll 1" OD x 11 gauge boiler tubes.

SIMPLE—Only a *single three-position trigger throttle* for off, forward and reverse. Never any danger of over-rolling because of improper sequence of operation. No juggling of switches; nothing new to learn.



CONVENIENT—*Furnished with an auxiliary handle that can be swiveled to any position desired* by the operator or left off when the torque reaction is not too great. Basic unit is of a pistol grip design.

TROUBLE-FREE—*Has an oil reservoir* built into the handle to supply lubrication to the motor. *The control section is independent of the motor and lubricated for life.*

CHUCK—*Simple, new type, snap on floating chuck. Only one motion* instantly engages or disengages a square shank mandrel—no set screws.

COMPACT—*Only 10" overall* from pistol grip handle to instant action chuck.

TW 660

These features speak for themselves. The Wilson air-driven Torq-Air-Matic tube expander drive and control is an important revolutionary advance in the field of precise tube expanding. Here's what you get when you use the Wilson Torq-Air-Matic control for heat exchanger tubes: (1) uniform and tight pressure joints, regardless of tube sheet hole variation; (2) no over-rolled or under-rolled tubes—no stresses that shorten tube life; (3) extended tube expander life, more production, higher profits.

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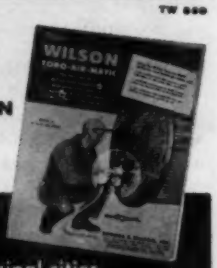

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this month's comment - -

floors without ceilings?

I have just read over a copy of ESA *News Digest*, the publication of the Engineers and Scientists of America. ESA is the "National Federation of Collective Bargaining Groups of Engineering and Scientific Employees," by self-proclaimed definition. I have no quarrel with the group, nor with their claim to the domain they have circumscribed for themselves.

But I wonder whether there are many engineers who want to circumscribe themselves as rigidly as that. ESA advocates that engineers be employed as engineers, not as anything less. I agree, as would most engineers, that freeing engineers to do engineering would do much to alleviate the current shortage of engineers. But is there not the danger that in supporting unions as mechanisms for raising the *minimum* level of skills at which engineers are employed, that there is also the danger of limiting the *maximum* to which engineers may go? Can there be a floor without a ceiling?

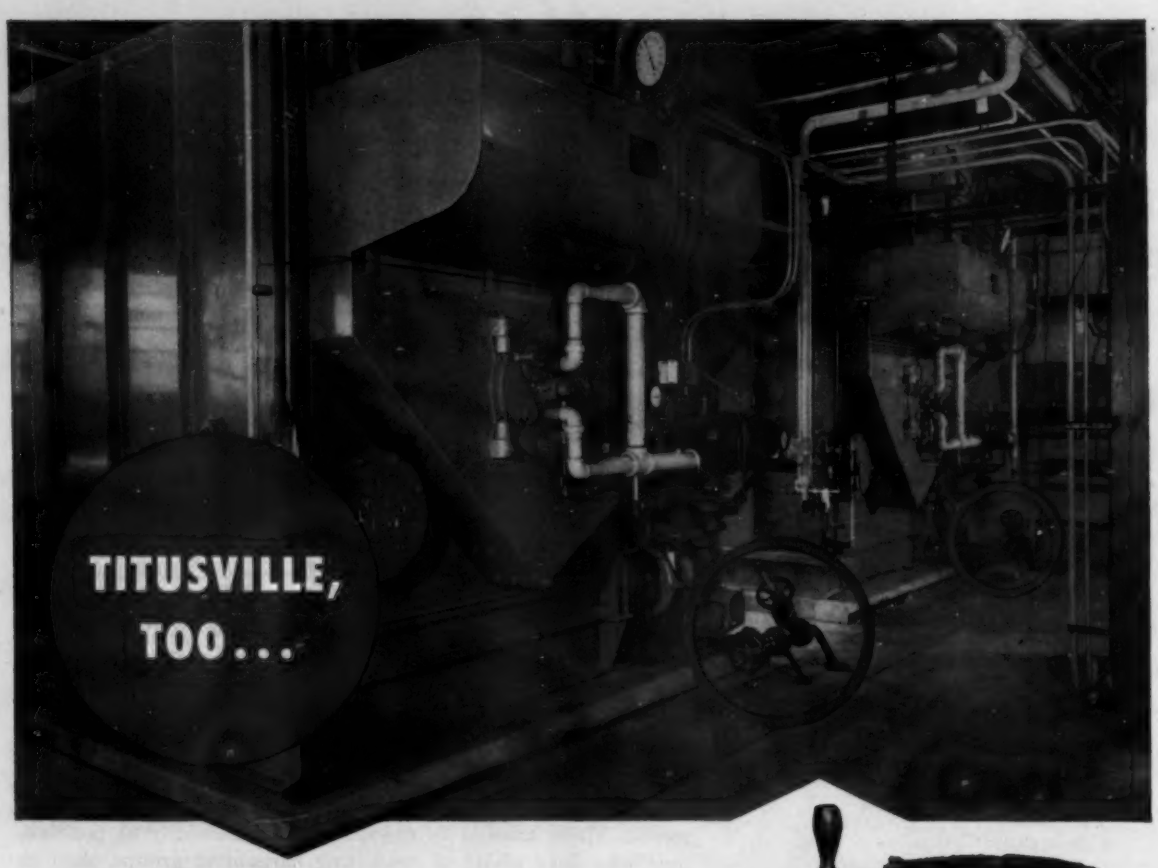
Jurisdictional disputes have long peppered the history of unions. These amount to negotiating, as peacefully as possible, the "who does what" of conflicting bargaining groups. And in rigidly circumscribing the lower limits of engineering as practiced, I fear we may also find the upper limits circumscribed as well. Sure, you can say that unions would encourage their members to reach whatever heights their abilities permit. But those heights imply that more than engineering skills are required. So unions would have to relinquish their hold on their more capable members. We return to the problem of engineers doing straight engineering.

Again, let me clearly say that we have no quarrel with engineers who seek to improve their lot as engineers. And I am sure that ESA can document need for much professional and economic progress for engineers as engineers. I am equally sure that ESA sees a role for itself in achieving this progress.

I have pointed out before, in connection with other matters, that you and I were men before we were engineers. Our basic drives for success, I believe, are a function of our being men. Engineering has developed as one profession among many by which we can achieve that success we hunger for. I do think that unions might be able to help engineers achieve more as engineers. But those engineers who are bigger than that, those who seek to achieve success fundamentally as men, might look again to see whether engineers' unions will carry them as far as they can, or wish, to go.

Harold A. Bergen

Editor



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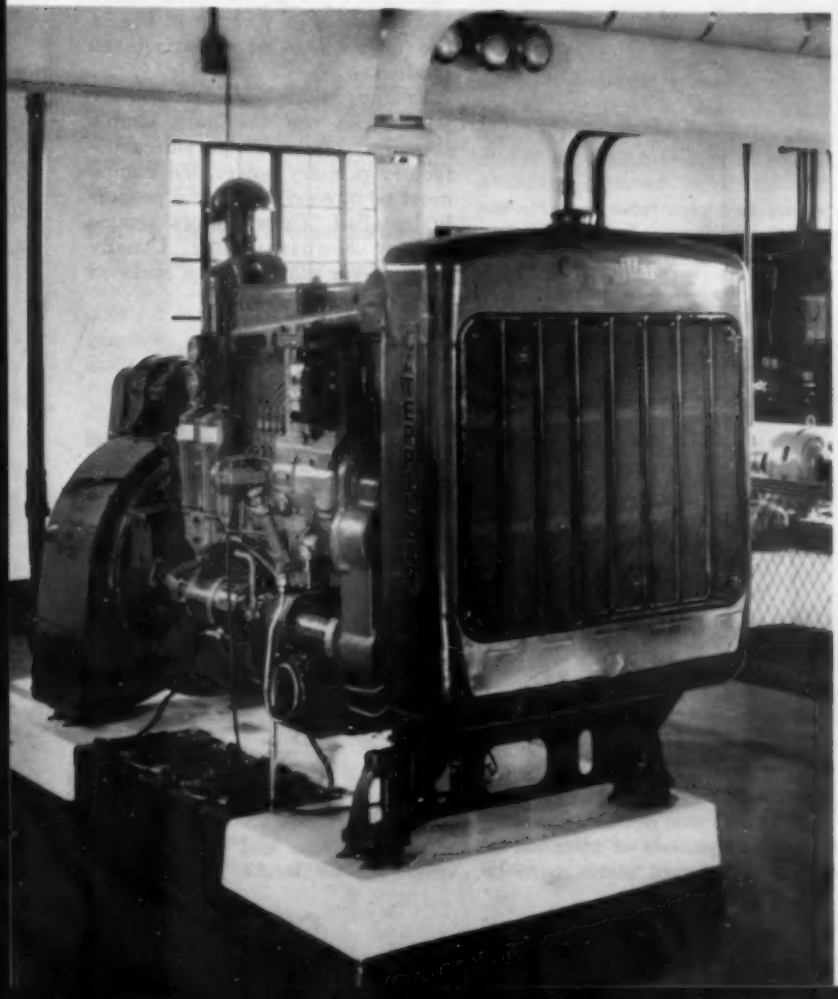
Before you buy . . . . survey diesel engine starting systems

T. A. WILLEY
Caterpillar Tractor Co.

Tom Willey is a graduate of Bradley University at Peoria, Ill. He served a four-year "hitch" in the United States Navy before joining Caterpillar in 1946. His experience has been primarily with engines, including a period in which he was a Caterpillar special engine representative in the South. He is currently working on special assignments in the Engine Division at Caterpillar.



SELECTING A DIESEL starting system can be perplexing. Several systems are available, but each one is best suited to certain applications. Quick, certain starting during a hospital emergency; subzero starting along the Arctic radar line; convenient starting for everyday usage in a sawmill—these are conditions facing users of diesel engine power in every phase of industry.

Electric, air, and independent gasoline engines are the three main systems for starting diesel engines. Selecting the proper starting method for an industrial application depends upon conditions under which the engine must perform, the job it is to do, and the limitations and advantages of each particular starting method in itself.

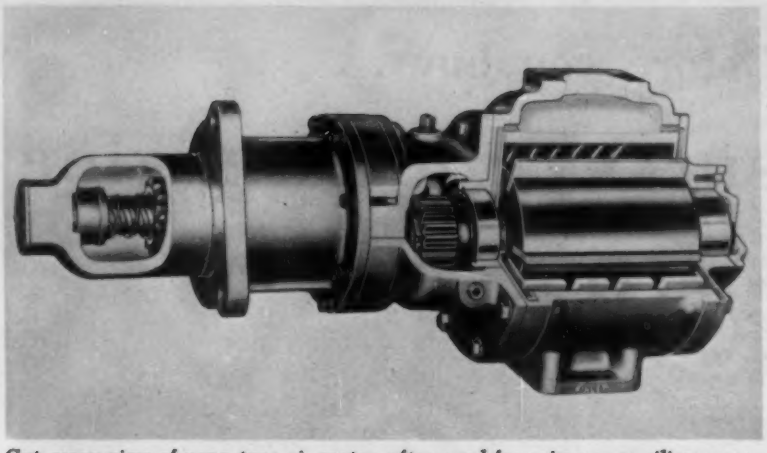
Requirements of a starting system

Before discussing engine starting systems and where they should be used, we should first decide the requirements of a good starting system.

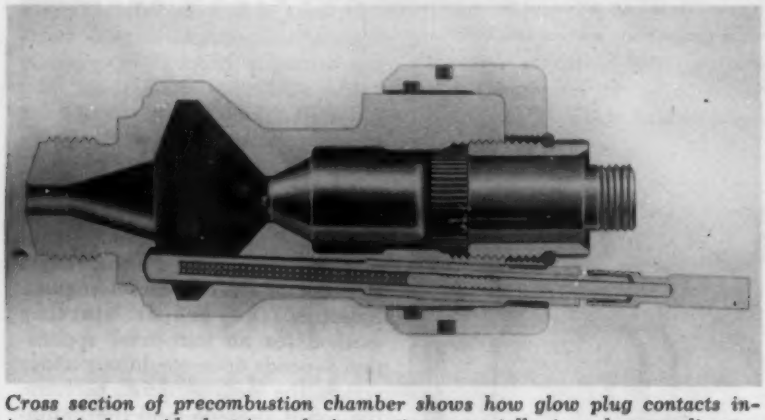
A starting system must have sufficient output to crank the engine fast enough and long enough to insure a start under all conditions. An ideal system would be capable of unlimited cranking periods at high speeds.

A starting system should always respond when called upon, regardless of conditions of operation. Dependability of the entire plant must be based upon dependability of the starting system. An ideal system would function perfectly every time it is called upon.

A starting system must be simple and convenient in operation. An



Cut-away view of vane-type air motor, often used for prime or auxiliary power diesel engine starting. Motor engages with flywheel through Bendix drive.



Cross section of precombustion chamber shows how glow plug contacts injected fuel to aid electric and air starting, especially in sub-zero climates.

ideal system would not require skilled or trained operators.

In meeting the first two requirements, convenience must sometimes be sacrificed because of conditions imposed upon the system.

Conditions govern which system

Conditions surrounding each installation will govern selection of a starting system and resulting performance.

Engines exposed to the elements present most difficult starting problems. Any internal combustion engine is, by nature, prone to be sluggish and unpredictable at low temperatures.

Not only do torque requirements become severe as temperature drops, but difficulty of igniting fuel also increases. Speeds at which a typical 16:1 compression ratio engine must be cranked to insure a start in 30 seconds without any starting aids are:

TEMPERATURE	CRANKING SPEED
100 F	25 rpm
80	50
70	72
60	95
50	150
40	225
35	280

High-temperature and humid conditions require fungicidal treatment of electric components in the starting system. At high ambient temperatures, battery charging equipment requires adjustment by lowering output voltage to prevent boiling the batteries.

Operations that demand frequent starts, long periods of idleness, or long runs between starts must be considered. Explosive atmospheres require suppression of spark- and flame-producing starting systems. Suppression of electric equipment to prevent radio, radar, and television interference is often required, particularly in military and broadcasting station installations.

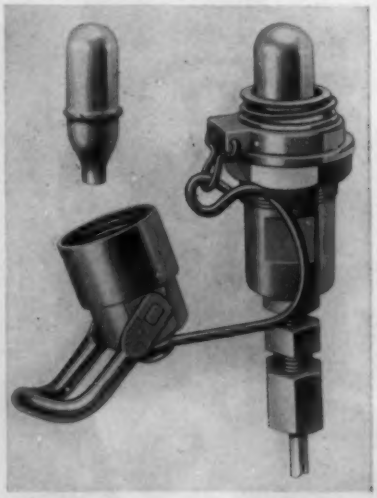
Frequency and quality of available maintenance must be determined. Improperly maintained engines are difficult to start and impose greater loads on starting systems. In fact, some starting systems will not operate unless they are frequently and competently serviced.

Proper study of engine location, fuel supply, and ease of maintenance should be made before installation details are considered.

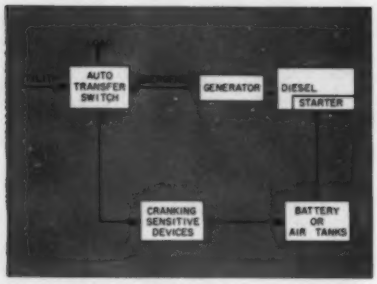
What service is engine for?

Engines installed for standby or emergency service must be arranged for fastest possible starts (often as quick as four seconds after prime power fails) and must be absolutely dependable. Installations of this type are found where loss of power may result in loss of life or spoilage of manufactured products.

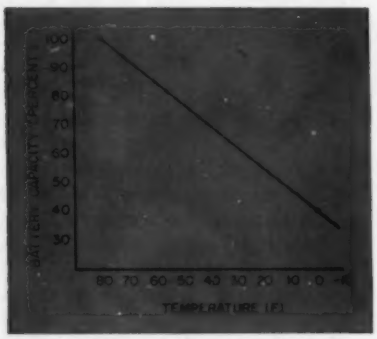
Engines that provide primary power can use the most simple starting systems. To provide satisfactory primary power, the engine must be in good repair and properly installed. These factors reduce starting requirements. Usually main power plants are in enclosed



Ether applicator and capsule inject ether into air intake, help starting.



Both air and electric automatic stop-start systems work in same sequence.



Graph shows effect of various temperatures on battery performance.

buildings not subjected to temperature extremes. Length of starting time is usually of little concern. Auxiliary power units usually operate under similar conditions.

Electric starting is most popular

Electric starting has long been most popular starting system available for standby and prime power because of its convenient push-button operation. Usual system consists of a series-wound dc motor mounted on the engine flywheel housing. This motor automatically engages with a gear on the flywheel, through a Bendix drive. Several types of Bendix drive are available, including friction clutch, overrunning clutch, and spring retract. Current is usually supplied by storage batteries.

Remember that output of an electric starting motor depends not only upon motor size, but upon amperage capacity of the battery supply system and size of connecting leads.

Also, electric starting is usually limited to a 30-second cranking period because of motor heating. Heating problems can be readily understood when it is realized that amperage draw of these motors may be as great as 800 amperes. Tremendous torque capacity of the series-wound motor accelerates the engine to its greatest possible cranking speed in approximately ⅛ of a revolution. Some provision must be incorporated in the gear drive for absorbing shock because of this great available torque and rapid acceleration of the motors. If large engines are to be started, a spring-loaded clutch included in the Bendix drive system is most satisfactory. During acceleration, this clutch slips momentarily, lightening the load on the drive.

Electric systems are not the most dependable ones because their reliability depends upon the maintenance given to storage batteries. A reliable battery charging system must be provided, and batteries must be serviced at regular intervals. Battery capacity is rated at 80 F by battery manufacturers, but at 0 F battery capacity is only about 40 percent of the 80 F rating. Like all dc equipment, commutator brushes and starting switches require periodic inspection and maintenance. Engines that are started frequently demand larger batteries and higher capacity charging systems, while those that are started infrequently must have protection against over charging.

Engines used for prime or auxiliary power often have compressed air starting systems. Compressed air starting systems fall into two categories:

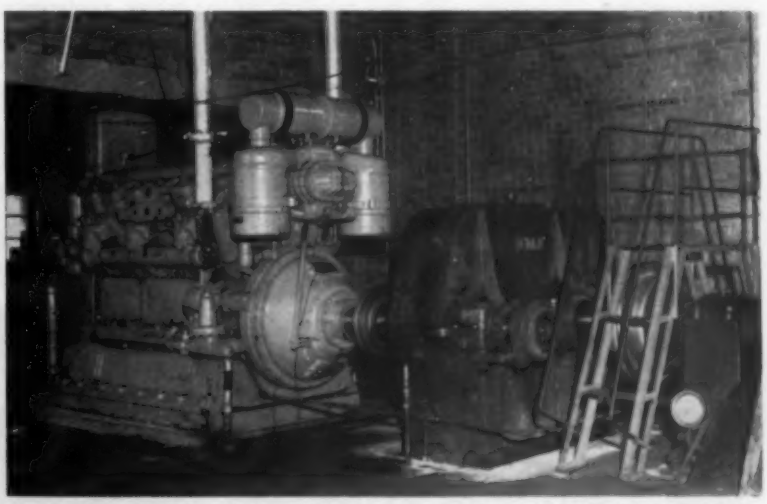
¶ A vane- or piston-type air motor installed on the engine flywheel housing to engage with the flywheel ring gear through a Bendix drive, similar to an electric system.

¶ Valves or a distributor mounted on the engine to inject compressed air directly into the engine cylinders. Engine runs as an air motor until it reaches a high enough speed to start running as a diesel. This system has drawbacks, however. A distributor (and its necessary valves) or cylinder head mounted air injection valves (all of which are operated from the engine camshaft) are extra maintenance items. Injecting air also introduces impurities, dirt, and moisture into the engine.

Air starting is convenient

Air starting cranks the engine at high speed and is almost as convenient as electric starting. However, cranking period is limited, depending entirely upon available air supply. To be dependable, air must be supplied by automatic or continuously operating compressor units. Automatic systems are usually controlled by pressure switches in the air storage tanks.

For maximum dependability, starting air supply should be kept separate from all other air supplies or requirements. Check valves



On this air-started agricultural drainage pumping engine, oil-burning flame-type intake air preheaters, located below the engine blower, aid in starting.

should be installed in air supply lines in front of and close to storage tanks, so that accumulated air supply is not lost if air supply fails.

Air starting systems require maintenance of compressors, compressor drives, air storage tanks, and connecting piping. Periodically, moisture should be removed from storage tanks to prevent its being blown into the starting motor or engine. Water may freeze, blocking supply lines and rendering the system inoperative.

Gasoline engines are used, too

Third main starting system uses an independent gasoline engine. After gasoline engine has been started, warmed up, and is running properly, a clutch coupled to its flywheel engages a Bendix drive. To help starting under severe conditions, a reduction gear or two-speed transmission is sometimes incorporated between gasoline engine and diesel.

Independent gasoline engine starting is successful where dependability and unlimited cranking are the most important requirements. This starting system is invaluable in extremely cold weather, for example. Independent starting engines may also be used to provide adequate prewarming, which lengthens engine life.

Preconditioning may be done in three ways:

¶ by connecting the gasoline engine cooling system into the diesel cooling system, thus heating the diesel jacket water

¶ by continued cranking of the starting engine to circulate oil through the diesel and assure adequate lubrication before loading.

¶ by circulating the starting engine exhaust so that it will warm the diesel intake air.

Horsepower capacities available for cranking are usually higher with gasoline engines than with electric or air starting motors, not because of the power of the gasoline engine itself, but because of first-cost economics involved. Gasoline engine starting is usually the most economical system that can be applied to a diesel engine, and maintenance costs are low because of the short operating periods.

On the other hand, gasoline starting engines may be considered somewhat lacking in convenience. They must be started either by hand cranking or by a small independent electric starting system. Gasoline engine starting cannot be used if fire hazards are present or immediate starting is needed (such as emergency supply systems in hospital and radio stations).

Determine which system you need

For most purposes, gasoline starting is probably the system to be recommended. Its reputation for dependability makes it outstanding. Engine preconditioning and very low maintenance are bonus benefits.

For emergency starts, for standby installations, or for moderate conditions where maintenance is good, both air and electric starting systems can be considered.

Both systems are well fitted to automatic starting, since the starting time involved is about the same for both. Amount of required maintenance and reliability are similar. When combined with glow plugs or ether aids, either system gives dependable starts at low temperatures. Air offers one advantage in that system capacity does not decrease with lowering temperature as do electric systems that depend upon batteries.

Automatics use either system

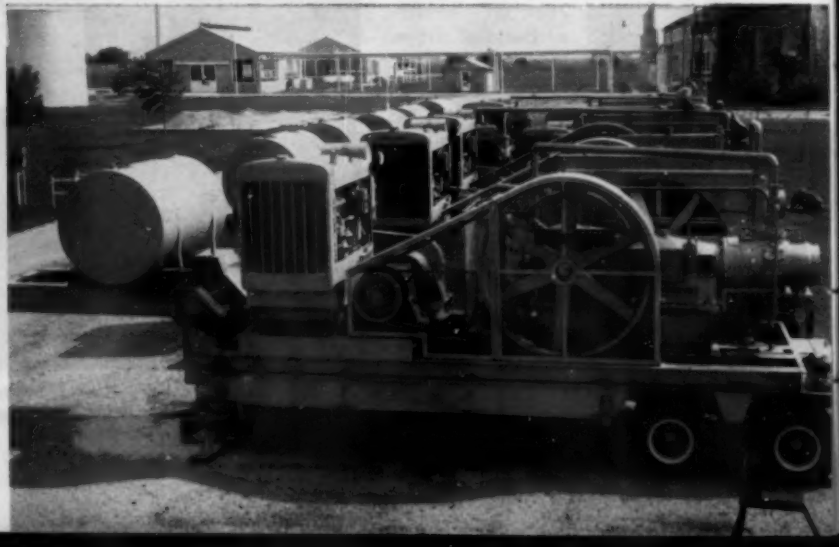
Automatic starting diesel engines almost always involve either electric or air starting. Systems are generally interchangeable, depending upon owner preference. In a plant which has a large compressed air supply for other services, air starting probably is preferable. Separate air supply tanks must be provided for the engine, and these tanks must be equipped with check valves to prevent loss of engine air supply in case of plant air failure.

Automatic starting systems can be initiated in a number of ways. One of the most common is found in emergency electric power generation equipment. Here, a magnetic transfer switch (held by the prime power supply) is released upon power failure. A set of auxiliary contacts is then closed, which actuates the starting system. In the case of an air starting system, power failure releases a normally open magnetic valve in the air supply line to the air motor. As soon as engine starts and generator provides voltage, the transfer switch closes, transferring the load to emergency engine supply. A tuned circuit incorporated in the closing coil of the transfer switch assures that connection to emergency supply will not be made until a full 60-cycle current has developed.

Apply to fire pumps

Similar systems may be applied to emergency fire pumps. A pressure sensitive switch is installed in the pump discharge line. When pressure drops below a predetermined level, switch closes and acts as an initiating contact operating into the same sequence. Any pressure, temperature, weight, or liquid

Portable diesel compressors air test pipeline in sections. Engines move from Detroit to Louisiana, so sure-fire starting in all climates is required.



Water pumping station uses independent gasoline engines to start diesels.

level sensitive switch may be used as an initiating device.

Automatic systems are now so well engineered that a properly installed, properly maintained system can be considered completely dependable. Automatic systems are providing power to such vital installations as Atomic Energy Commission Plants, where as many as ten 500-hp diesels are expected to start at one time.

Starting aids may help

Several devices can be incorporated into the engine to make starting easier. One obvious device is a jacket water heater, which is connected so that water will flow through it and the engine on a thermo-siphon principle. Heat is provided by electric immersion elements, or by gas or oil burners.

Glow plugs, nichrome elements insulated and clad with heat-resistant covers, are often installed in the engine combustion chamber. When diesel fuel is injected, it impinges upon the heated element (which reaches 1800 F within 45 seconds) and ignites. Faster starting results. In some applications, if glow plugs are heated by ac current, they may be left on continually (as jacket water heaters to keep engine temperature up).

Priming the engine with ether has long been a common way of assuring fast engine starting. Several methods are in use — some as simple as holding an ether-soaked rag over the engine intake. However, a safer method of containing the ether under high pressure in sealed cartridges, similar to seltzer cartridges, has been developed. Cartridges are shot in a special fixture, and ether is discharged through tubing into the intake manifold. Thus, ether is kept away from operators and fire hazards are eliminated.

Burning gasoline or oil in the engine intake manifold is another starting aid. Fuel oil is sprayed into the manifold by a small hand-operated pump and is ignited by a spark from an ignition coil. Engine is cranked and, as the fuel burns, it heats incoming air.

Lightweight oils, such as SAE 10, have made cranking easier at lower temperatures. However, care must be exercised in operating an engine with these light-bodied oils to assure that adequate lubrication is maintained.

Less common systems used

Hand starting has been applied to small engines. To make this possible, a device usually is incorporated into the engine whereby compression may be released from the cylinders while the operator is cranking. When engine is rotating at fair speed, compression is restored so that the engine can start.

Some applications use ac starting systems, but they fall short as emergency systems because they rely on utility power. Contrary to first impression, ac starting systems cannot provide unlimited cranking. Because of economic considerations and reasonable space requirements, ac motors are small and tend to heat quite rapidly at the high amperages drawn. Adequate supply lines for motors of this type must also be provided. Starting switches need maintenance. In physical size and form, the ac motor closely resembles the dc starting motor.

Inertia starters have been applied to small engines in warm climates. System consists of a flywheel that is handcranked to extremely high speed and is then engaged to a Bendix drive through a clutch. Thus, inertia from this handcranked flywheel is transferred to the diesel, turning it over a few times.

Explosive cartridge starting systems have been applied to at least one foreign-made diesel engine and were fairly popular at one time on aircraft engines. An explosive cartridge, usually of gunpowder, is loaded into a closed cylinder in which there is a piston connected to the diesel flywheel by a toothed gear rack. When cartridge explodes, the rack drives the flywheel at an extremely high speed, thus cranking the engine for a short time. Needless to say, this system does not provide a long enough cranking period to completely insure starting.

Recently developed hydraulic starters are becoming more popular. Most common form is a vane or piston-type hydraulic motor connected to the diesel flywheel through a Bendix drive. For the initial start with this system, hydraulic fluid is pumped by a hand-operated piston pump into a spring-type accumulator under as much as 6000 psig pressure. When accumulator is up to pressure, a valve is released, admitting hydraulic fluid to the starting motor. A small hydraulic pump (driven by the diesel) supplies the accumulator with oil after the engine is running. Initial starting time is quite long because of the slow hand pumping process, and cranking period is limited. Dependability depends entirely upon the pressure-holding capacity of this system, and its ability to crank the engine for a long enough period of time.

Some diesel-electric generators, particularly traction generators used in railroad locomotives, have starting windings incorporated in the generator fields. When dc current is applied to these windings, generator acts as a motor, cranking the diesel engine.

Investigate dual systems

Do not overlook the possibility of applying dual systems. An engine equipped with a gasoline starting engine and electric starting would offer the assurance of positive starting, regardless of conditions. Another advantage is the convenience of pushbutton starting, for subsequent starts after the engine is warm.

Choose the starting system with care. Install and maintain the system properly. Your satisfaction with a diesel engine is dependent upon how readily the unit starts.

COOL your plant with central units

R. D. McLAIN, Manager, RK Division
United States Air Conditioning Corporation

Central board provides control of six independent air-conditioning systems. Temperature, humidity, and data on condition of the supply air are recorded.

PLANT AIR CONDITIONING that uses 640 total tons of self-contained, central station equipment and occupies no interior floor space is one outstanding feature of the new Ebco Manufacturing Company factory.

Believed to be the largest single installation of self-contained, central station units, the unique system provides all-year comfort for the one-story, 240,000-sq ft structure. The building is widely hailed for its many unusual design innovations and functional simplicity. Building was constructed by F & Y Building Service, Inc. Design architect was Merle Robert Maffit, AIA.

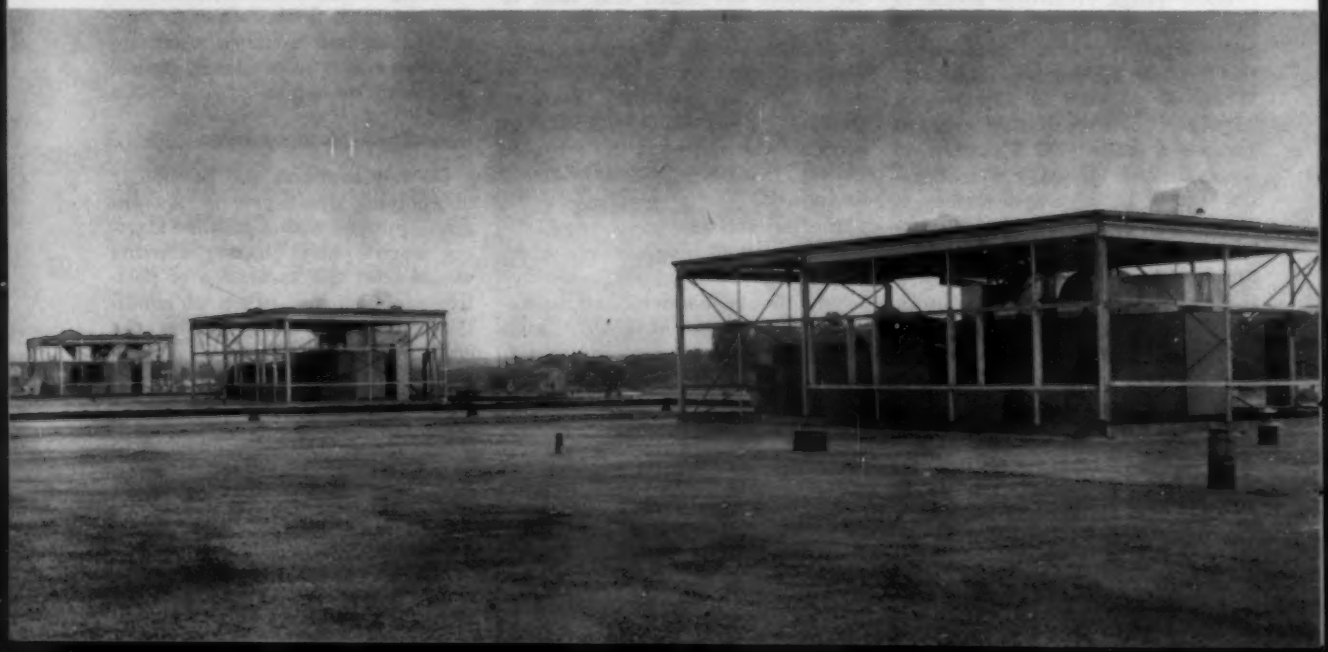
Factory building was designed virtually windowless with inclusion of year-round air conditioning as a prime consideration.

Penthouses contain equipment

Zoned-plan refrigeration was selected to solve the immense cooling problem. This decision was reached after consultations between L. P. Benua, vice president and works manager, H. C. Fischer, chief engineer, and Ebco's engineering staff. This plan called for housing refrigeration equipment in six large penthouses constructed on the roof. Each penthouse contains an individually operating 100-ton air-conditioning system to serve a separate section of the building.

Two possible equipment selections were considered — the re-

Each of six roof penthouses have two 50-ton air-conditioning units. Separate cooling zones are served by each penthouse.



mote, built-up type, and the factory-assembled, central station unit.

Built-up system under consideration called for installation of a 100-ton compressor in each penthouse, with a separate air handling unit and direct expansion cooling coil. A separate evaporative condenser would be installed adjacent to each penthouse. Steam coils would be provided in each air handling unit for heating. Steam is furnished from two 300-hp boilers, which also serve certain manufacturing processes.

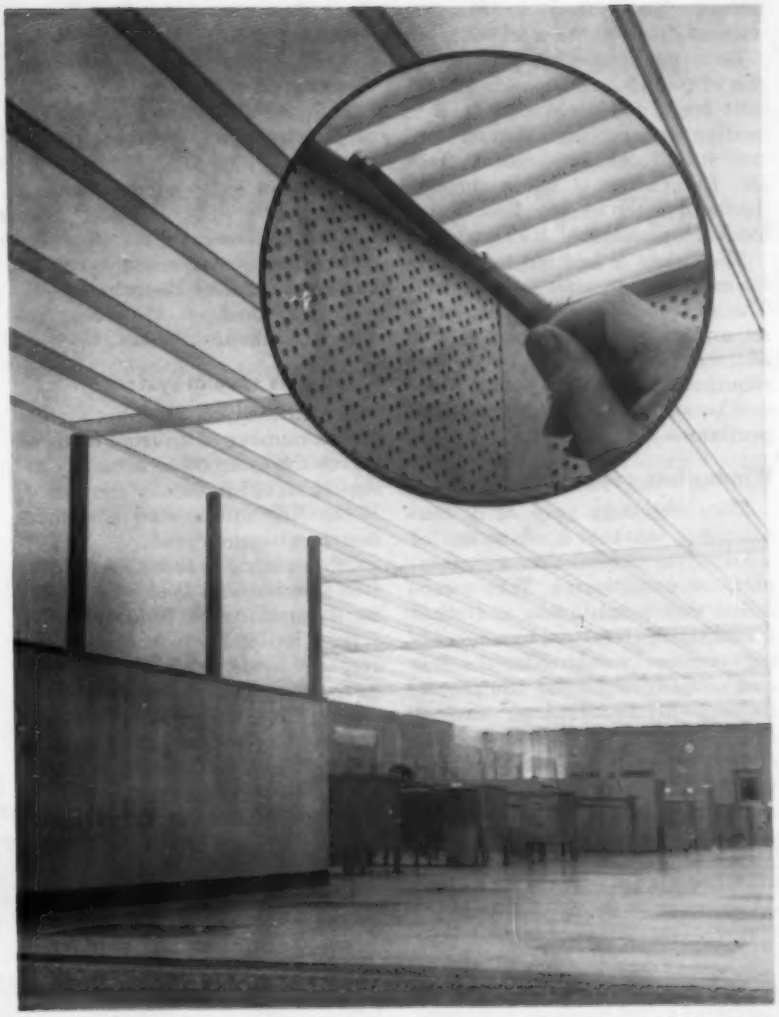
Built-up system disadvantages

This system offered a number of disadvantages that could be eliminated by the selection of factory-assembled, central station units. First was expense — initial equipment cost, as well as installation, operation, and maintenance cost. A built-up system requires extensive refrigerant piping to air handling units and evaporative condensers. Also required were steam piping and condensate return lines to and from the boilers. Permanent employment of both a state-licensed refrigeration engineer and state-licensed fireman would have been mandatory. Their combined wages of these two additional men were estimated to be $12,000 per year.

Refrigerant pump-down would be required during cold weather months, leaving the units available only for heating. This would limit the flexibility of the system. Cooling facilities would not be available for certain building areas in case of unseasonably warm weather.

Ebco management and engineers recognized advantages and economies gained by using central station units. This decision was reached after consultation with Donald Delp, the United States Air Conditioning Corporation representative. RK units contain, in a single casing, all the air-conditioning plant elements, including evaporative condenser. The condenser was necessary in consideration of the water savings it would effect.

Units are factory assembled and tested. Installation was accomplished on the job with only three connections — to power, ducts, and water supply and drain. Each unit was positioned on the roof in one piece, thus eliminating further on-site labor costs.



Luminous ceiling is supported by tracks hung from ceiling above. Uniform air distribution is provided through the openings between corrugations and track.

Two 50-ton units occupy each 25 x 35 foot penthouse. Direct-fired, 1,750,000 Btu/hr (gas, oil-fired auxiliary) heating unit with stainless-steel heat exchanger is also installed in the penthouse.

Blowers in RK units provide all ventilation within the plant, as well as circulation of cool and warm air as required. Ventilation is selected manually, while cooling-heating changeover is automatic. Both cooling and heating are available at all times.

System required attendance of a night watchman only. No additional expense is involved for special personnel. Control system is designed so that the watchman can make required adjustments during nonworking hours.

Controls and distribution

Each roof penthouse serves a separate plant zone. The six independent systems are controlled from a central control board where all pertinent data are available. Recording thermometers installed in the maintenance department show outside temperature and humidity, air leaving conditioners, and individual zone conditions.

Supply air ducts deliver conditioned air to the nearby zone. Air is discharged directly from ducts at relatively high velocity over a 75-foot radius. Ceilings 22 feet high

permit this system to function without drafts at the working level.

Each penthouse supplies 40,000 cfm of conditioned air, with 25 percent fresh air introduced in both heating and cooling. Manual control introduces 100-percent fresh air. Return air is taken through dampers in the ceiling directly below each penthouse.

Ebco plant is laid out to provide for expansion to meet future needs. The air-conditioning system, with its unitary central plants, can be adapted to meet increased cooling requirements. Newly created zones can be served by adding identical penthouse arrangements.

Windowless construction

Ebco engineers gave early consideration to the combination of windowless construction with complete air conditioning. They established that construction and other initial savings, realized by eliminating windows, would offset the first cost of air-conditioning equipment. Subsequent maintenance savings are expected to exceed cooling system operating costs. This provides a net overall saving for the combination of air conditioning and windowless construction.

Economies involved in eliminating windows are broken down into six categories:

1. Construction — window cost more than conventional wall construction.
2. Maintenance — no breakage, cleaning, or puttying.
3. Space utilization — better use of interior space possible without windows.
4. Shades — no window shading required.
5. Disturbance — no employee distractions from nearby airport and other outdoor disturbances.
6. Heat load — 15-percent reduction without windows.

Office uses special system

Separate air-conditioning system with a number of unusual features serves the main office area. It consists of an automatically controlled, 30-ton RK unit located in a mezzanine equipment room.

Office ceiling is luminous to provide glareless and shadowless lighting at intensity of 70-foot candles (about double the light level of the average home kitchen). It also serves as a reservoir for supply air. Ceiling consists of corrugated, translucent plastic sheeting. Ceiling rests on extruded aluminum tracks suspended from the regular ceiling. Sufficient fluorescent lights are attached to the regular ceiling to provide desired lighting level.

A four- to seven-foot high enclosure formed by the regular and plastic ceilings and the four walls serve as the reservoir. Higher pressure prevailing within this space forces conditioned air through openings between the corrugations in the plastic ceiling and the tracks on which it rests. Uniform air distribution to the office below is provided through the large number of openings.

Return air enters through floor registers adjacent to the exterior walls. Air enters a subsurface concrete duct and flows to a point below the air-conditioning unit. A concrete shaft delivers the air to return air dampers at the unit.

Heat loss in the return air duct, which is located directly under the concrete floor slab, keeps the floor warm during winter.

High intensity lighting has increased the cooling load in the offices by 30 percent. Cooling is required in the office area due to internal load when outside temperature reaches 50 degrees. This load is handled by a separate 30-ton unit located on the mezzanine. Another 10-ton RK automatically controlled unit provides cooling for the spacious building lobby. The conference room is cooled by a separate 7½-ton upright packaged unit.

Locating air-conditioning units in noncritical areas is an important part of modern functional design. The installation at Ebco is typical of a well planned, efficient plant.

Importance of Fuel

"The use of electric power in the United States appears to be growing at the rate of around 8 percent per annum. This can hardly be considered a reason for surprise or special gratification. Annual increments of even 10 percent are not uncommon in our energy economy. Continued annual increments of 10 percent would mount up to a 100-fold increase in 50 years (which would seem formidable enough to public utilities), but during the past 50 years the total capacity of the world's equipment for production of all kinds of power from heat increased about 100-fold. This includes, of course, the internal combustion engine. . . .

"Consumption of fuel for generation of electric power is about a fifth of the total consumption of fuel for power purposes in the United States, and for several decades this proportion has shown no marked tendency to rise. In spite of its relatively low cost and its generally attractive features, electric power is still far from predominant even in the power category. Successful development of economical nuclear power is not the answer if fissionable material is to be used merely to generate a part of the heat that would otherwise be generated by the combustion of only about 12 percent of our total annual fuel supply.

If revolutionary forms of electric power should actually be conceived and developed, present-day generators, motors, and appliances might become obsolete, but the eventual effect on our economy should be favorable by extending the scope of electric power applications. I believe that most of us have an intuitive faith that electric power is at an early point in its growth curve, and that in the world of tomorrow we shall utilize electric power for almost all of our energy needs, including space heating. The market for space heating is now almost three times the total electric load in the United States."

. . . Eugene Ayres
Consultant
Gulf Research & Development Co.

Precise CONTROL is needed when you use ADJUSTABLE-SPEED MOTORS

G. W. HEUMANN
Industry Control Department
General Electric Company

SPEED ADJUSTMENT and precise motor control are vital in light of present trends to increased automation in Industry's Power Services. General-purpose adjustable-speed motors in industrial plants maybe either multi-speed squirrel-cage motors, wound-rotor motors, or dc shunt motors.

Clear understanding of load characteristics is necessary before selection of controller for an adjustable-speed motor can be made. Motor performance under controller influence then can be matched properly to load requirements. There are two basic types of loads (Fig. 1). One type is friction load, which does not change significantly with speed. Torque is constant over the speed range, and horsepower varies proportionately with speed. An example of friction load is that encountered on cutting-type machine tools. Controllers designed for such constant-torque applications are sometimes known as controllers for machine tool duty.

Transporting viscous fluids is another basic load type. A large portion of drive energy is used to accelerate fluid. Thus, torque varies as the square of speed. Horsepower varies as the cube of speed. Examples are fans, centrifugal compressors, and centrifugal pumps.

Typical of controls for adjustable-speed motors is this air conditioning system installed in The Irving Trust Building, New York City. O. H. Kupper, Chief Engineer, is shown checking controls of this modern, neat-appearing installation.

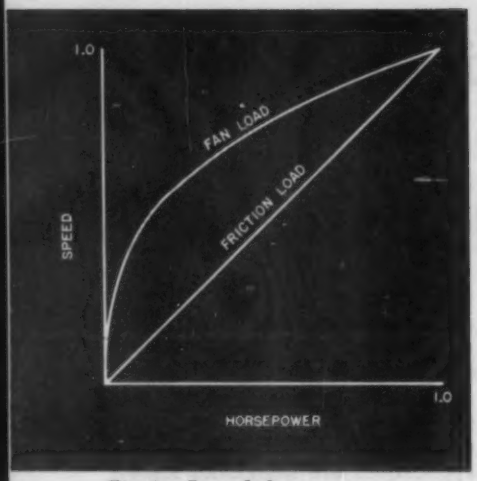


Fig. 1—Speed-horsepower curves.

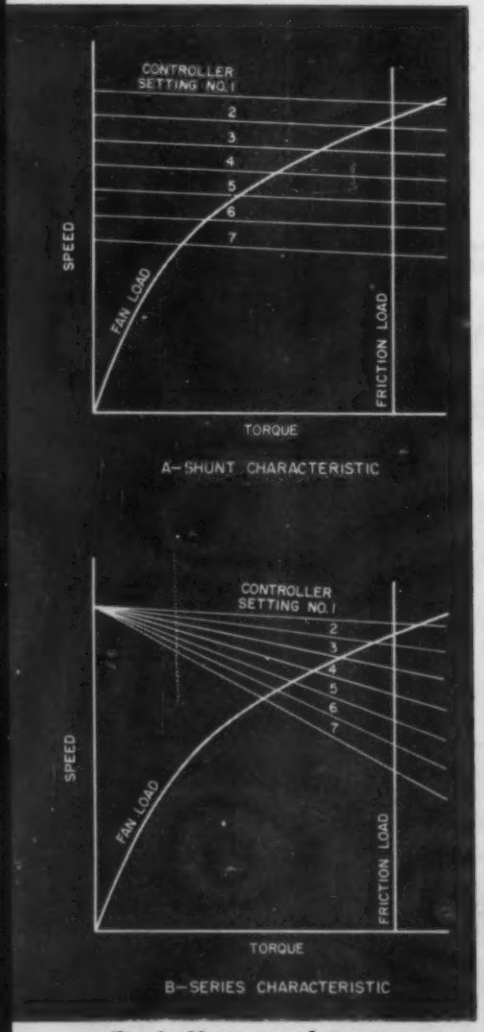


Fig. 2—Motor speed-torque curves for series and shunt characteristics.

This type is generally called fan load (Fig. 1). Controllers designed for such applications are designated as controllers for fan duty.

Actual industrial loads are often a combination of friction and viscous load. Under these conditions, speed-torque and speed-horsepower relationships fall between the two extremes. An example is a centrifugal pump transporting liquid through a pipeline. Such a load may be called a variable-friction load, since friction between liquid and pipe walls is superimposed on pump load. It is important to know approximate load torque versus speed relationship for proper controller selection.

Speed-torque characteristics

Motor performance can be visualized by plotting speed-torque characteristics. Such characteristics indicate how motor speed varies with changes in load. Basic speed-torque relationships are plotted for motors having shunt and series characteristics in Fig. 2. Lines correspond to a certain controller speed setting. Torque lines are superimposed for both friction and fan load. Steady-state operating speed is obtained by intersection of motor line and torque line.

Shunt characteristics are those obtained with a dc shunt motor (Fig. 2A). Each line represents a speed setting obtained by adjusting the field of a shunt motor connected to a constant-voltage source. Same setting may be obtained by adjusting the armature voltage of motor connected to an adjustable-voltage source.

Similar characteristics are obtained with multispeed squirrel-cage motors. Motor speed is substantially constant for each speed setting over load range from no-load to full-load on shunt characteristics. Total speed change amounts to only a few percent. Thus, there is only a slight variation in speed between friction and fan load for each speed setting. Exact knowledge of load characteristics is not vitally important for a shunt motor, provided that motor has sufficient capacity to handle maximum load which may be imposed on the driven machine.

Characteristics of Fig. 2B resemble those of a dc series motor in that speed changes appreciably with motor load. This characteristic is obtained with dc shunt motors controlled by resistance in motor armature circuit, or with wound-rotor motors controlled by resistance in secondary circuit. Motor speed for a given setting varies considerably with friction or fan load. Hence, for motor with series characteristic, at least an approximate knowledge of load characteristic is essential for selecting proper resistor.

General-purpose controllers do not include speed-regulating means. One certain full-load speed exists for each control speed point. To obtain desired optimum speed for each controller point under actual load conditions, it is essential that controller design include sufficient flexibility to adjust for speed desired at the installation.

Squirrel-cage motors can be obtained with special stator windings that can be connected for different numbers of poles. Multispeed motors operate at several distinct speeds and require control in several definite speed steps. Number and spacing of steps is determined by stator winding design. At each speed step motor operates like conventional squirrel-cage motor having shunt-type speed-torque characteristic.

Windings change speed ratio

Two types of stator windings are in use. Single consequent-pole windings can be reconnected to obtain two numbers of poles that are in a 2:1 ratio. Two independent superimposed windings may be used. These may have any speed ratio. Either or both of the superimposed windings may be consequent-pole type, resulting in three- and four-speed motors.

Three motor categories are available. Constant-horsepower motors develop the same horsepower at all speeds, and torque is inversely proportional to speed. Constant-torque motors develop the same torque at all speeds, and horsepower varies in proportion to speed. Variable-torque motors develop torque proportional to speed. Thus, horsepower is proportional to the square of the speed.

Starters for multispeed motors are combinations of full-voltage

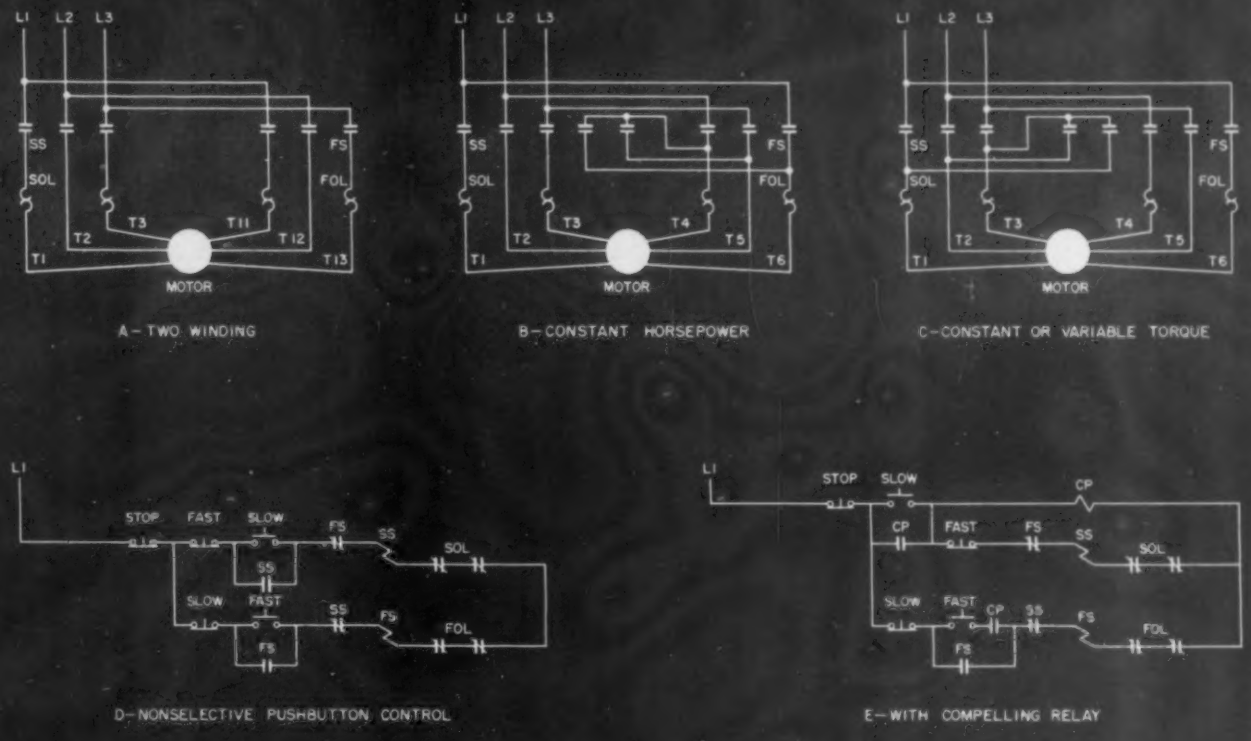


Fig. 3—Two-speed motor starter circuits used for adjustable-speed requirements. SS—slow speed contactor; FS—fast speed contactor; SOL—slow speed overload relay; FOL—fast speed overload relay; and CP—compelling relay.

starters for each winding combination. Triple-pole line contactors are used for superimposed windings. Combinations of triple-pole and five-pole contactors are used for consequent-pole windings. Selection of optimum power circuit combination depends on motor stator connections which must be known. Motor full-load currents are different for various speed points. Consequently, separate overload relays for each speed connection are required to obtain complete protection at all speeds in the operating range.

Control circuits (Fig. 4D and E) can be used with either power circuit. Nonselective circuit D is used when motor may be started on either high- or low-speed winding. Back contacts on pushbuttons permit switching between speeds without shutting down motor. On some applications it is desirable to start at slow speed before switching over to high speed. In such cases, a starter is used with a compelling relay (Fig. 4E).

Speed of dc shunt motor can be raised above its base speed by decreasing shunt field. So-called constant-speed motors generally have speed range up to 2:1. Motors listed as adjustable-speed have a speed range up to 4:1. Special motor designs are available with even higher speed ranges to satisfy special industrial applications.

Adjustable-speed controllers

Adjustable-speed motors are started and run up to base speed with resistance in the armature and with full field. Motor is then accelerated to its preset speed by decreasing the field. Line contactor has a normally open pole for motor starting and a normally closed pole for dynamic braking. Accelerating contactors have normally closed contacts. They drop out with a time delay when the coil circuit is interrupted. Field accelerating relay FA has both shunt and series coil that accelerates motor from base to preset speed. Field discharge resistor protects field against high induced voltage when motor circuit is disconnected at the switchboard. Stabilizing series field S1-S2 is provided. It is included in many adjustable-speed shunt motors to prevent speed rise with high loads caused by the field weakening effect of armature reaction.

Controllers differ somewhat in how various control functions are accomplished. However, they all include some or all of the control features indicated in Fig. 6. With motor at standstill, accelerating contactors 1A and 2A are picked up and starting resistance is inserted in the motor armature. Also, field accelerating relay FA is energized through its shunt coil, short-circuiting the field rheostat. This applies full field and gives high starting torque. Pressing START button closes M, causes current to flow through motor armature, and starts the motor with all resistance in series.

Interlock operations

Interlock on M deenergizes 1A, which drops out with time delay and short-circuits the first starting resistor section. Interlock on 1A deenergizes 2A, which drops out with time delay, short-circuiting

remaining section of the starting resistor. Motor armature is now across full voltage, and motor accelerates to base speed.

On controllers for constant-speed motors, FA has a shunt coil only. Thus, rheostat is inserted in series with shunt field. Motor accelerates to its preset speed. On controllers for adjustable-speed motors, FA is equipped with current coil in series with armature. FA then acts as a field accelerating relay. If severe field reduction causes sharp increase in armature current, FA acts to successively close and open its contact around field rheostat until motor has accelerated to preset speed and motor current has dropped to normal.

Use dynamic braking control

Dynamic braking can be obtained as an optional feature. When motor is stopped by pressing STOP button or by tripping overload relay, line contactor M drops out. The normally closed pole of M short-circuits the armature in series with braking resistor. Holding coil across armature insures adequate closing force on dynamic braking contact.

Field reduction is accomplished by either manually operated or remotely motor-operated field rheostat. To select the rheostat, it is necessary to know cold resistance of shunt field and field current at maximum speed. Cold field resistance is used to make certain that maximum speed is reached before motor has warmed up. If motor is equipped with full-voltage field, total required rheostat resistance equals line voltage divided by minimum field current, minus field resistance. If motor is equipped with partial-voltage field, a fixed block of resistance should be connected in field circuit to avoid field overheating with rheostat cut out. Standard handbook rheostat listings give current-carrying capacity on first and last step. These current values should not be less than maximum and minimum field current values.

Adjustable-voltage control

Greater speed range for dc shunt motors can be secured by varying voltage impressed on armature. This also obtains speed-torque curves as illustrated in Fig. 2A. Speed ranges of 10:1 can thus be obtained with standard motors. Greater speed ranges have been obtained with special designs. Combining control by armature voltage with control by field reduction, total speed range can be extended to 40:1.

Conversion units are needed to supply required controllable dc power from ac power system. Such conversion units are generally sold by manufacturers as a coordinated unit. They contain power conversion apparatus and associated controls in a single package. One unit available consists of motor-generator set, with belt-driven exciter and magnetic control panel all assembled in type 1 enclosure. Motor speed is controlled by varying generator shunt field strength. This, in turn, varies generator voltage. Another frequently used power conversion unit is the electronic rectifier. One model uses thyratron tubes as power converters with dc output voltage being controlled by phase shift of tube grids.

Adjustable-voltage systems are very flexible. Special regulating circuits using electronic or magnetic amplifiers can be worked into voltage control with ease. This adapts the basic system to specific operating conditions demanded by the drive. Accurate voltage control, speed, current, and tension is possible. Choice between rotating or electronic power conversion is determined by specific technical details of drive system. Also, relative cost will determine which conversion system is most attractive for specific applications.

Offer complete systems

Conversion systems are not sold separately. Electrical manufacturers offer complete drive systems comprising motor and conversion units. They thereby assume full responsibility for proper coordination of all system components. It is recommended that the user draw up functional specifications setting forth technical requirements of his drive. Electrical manufacturers then assume the task of working out details of the drive system.

Speed of wound-rotor induction motors is reduced by inserting resistance in rotor circuit through motor slip rings. Load current in the rotor causes voltage drop in resistor, resulting in reduced speed. The motor must be carrying load. A lightly loaded motor will not run at substantially reduced speed no matter how much resistance is connected in rotor circuit. Because speed varies considerably with load, speed reduction below 50 percent at full load is seldom if ever exceeded.

It is necessary to know "normal ohms" (total rotor circuit resistance per phase to obtain starting torque equal to rated motor torque) to lay out resistor for a wound-rotor motor. This resistance is not a standard quantity. It is not apparent from motor nameplate, and must be obtained from motor manufacturer. Motor speed per unit of synchronous speed obtained with friction load and fan load is plotted for various resistances in rotor circuit in per unit of normal ohms.

Precise control is necessary

Wound-rotor motors with speed control are often used for large ventilating and air conditioning equipment. In these instances, fan or centrifugal compressor represents a definite load for which the resistor can be designed. Fan or compressor capacity is changed by motor speed change. Since a considerable number of speed points is usually required, motor secondary control is generally manually or motor-operated drum switch. Motor-operated switches are preferred on large motors where effort of turning switch by hand would require considerable physical exertion. If total resistance is not adequate to sufficiently reduce starting current, an additional starting resistor section and one or two accelerating contactors may be supplied. To form complete control equipment, secondary controller is used in conjunction with primary circuit breaker with overload relays or with starting panel.

Complexities involved in selection and use of proper motor control equipment are significant. However, advantages are readily apparent in better operation and performance and, most of all, in the operating cost statement.

It's easy to control boiler room operation

D. W. KARGER
Chief Plant & Industrial Engineer
The Magnavox Company

GOOD BOILERHOUSE operation and maintenance can be achieved in any size plant with the help of judicious planning, complete reports, and informative charts. Our engineering staff has devised a report control system that has proved to be of great value to our firemen, operating engineers, and the plant engineering office alike. It is obvious that exactly the same reports could not be used in another plant installation, but the same basic approach, and even many individual items, could be utilized to give similar results.

Boiler plant installation involved has, as its major operating unit, a 250-hp, A-type, water tube boiler operating at 80 psig and fired by a spreader stoker. It is an outdoor-type boiler and only the firing bay is enclosed. Supplementing this main boiler are three low-pressure fire tube boilers, fired by underfeed pusher stokers. These boilers operate at 15 psig and are put on the line only at peak loads or when the water tube boiler is down for maintenance.

Semiproportioning, hydraulically operated controls are used on all boilers with normal instrumentation. On main boiler unit, an air-flow-steamflow meter has been installed for additional control.

Boilers are operated by state-licensed firemen. Each man, as part of his daily duties, completes a fireman's daily report. Report form we use for the main boiler is shown in Fig. 1. A similar report is completed for the fire tube boilers.

No coal weighing

Our boilerhouse, being typical of those found in medium-size industry, is not equipped with automatic coal weighing scales or other devices of that type. This makes determination of operating efficiency more difficult.

We have taken a very practical approach to this problem. Operating efficiency calculations, even though they may not be absolutely accurate, go a long way toward securing economical boiler operation. Coal usage is needed for efficiency

DAILY BOILER OPERATION AND TEST REPORT.
NICKES BOILER. Sheet No.

OPERATOR _____ SHIFT _____ DATE _____

ITEM	DATA	TEST VALUES START	END	CHANGE
A.	Time of Readings..	___ H ___ AM PM	___ H ___ AM PM	___ H ___ M
B.	Softener Recharge Time.	___ H ___ AM PM	___ H ___ AM PM	___ H ___ M
C.	Softener Meter Reading.	_____ Gal.	_____ Gal.	_____ Gal.
D.	Madden Blowdown Setting.	_____	_____	XXXXXXXXXXX
E.	Bottom Blowdown Time.	___ H ___ AM PM	(Required once daily.)	
F.	Hagan Integrator Dial.	_____ #	_____ #	_____ #
G.	Net Steam Flow = Item F change times 300 =	_____	_____ #	Steam.
H.	Coal Conveyor Counter.	_____	_____	_____
J.	Coal Conveyor Time Meter.	_____ Sec.	_____ Sec.	_____ Sec.
K.	Weight of Coal Used = Item J change times 5.277 =		_____ #	Coal.
L.	Weight of Coal per Fill = Item K ÷ Item H change =		_____ #	Per Fill.
M.	Steam to Coal Ratio = Item G ÷ Item K	=	_____ #	Steam per # coal.
N.	Ashes Removed (Wheelbarrow Loads) _____ X	=	_____ #	# ashes.
P.	Ash to Fuel Ratio = Item N ÷ Item K	=	_____ #	Ashes/# coal.

RULES: 1. Fireman must write in all start values at the beginning of his shift. He must write "NONE" in the space if he can not obtain any reading.
2. All other blanks will be filled and calculated by I. E. Department.
3. Every 4 hours, the fireman must record the percent CO_2 reading - from the analyzer - on the Hagan Chart.
4. Write below all special data and unusual occurrences.

NOTES: _____

Signature _____ Fireman.

Fig. 1—Engineering department designed its own forms. Firemen must complete this report form each shift.

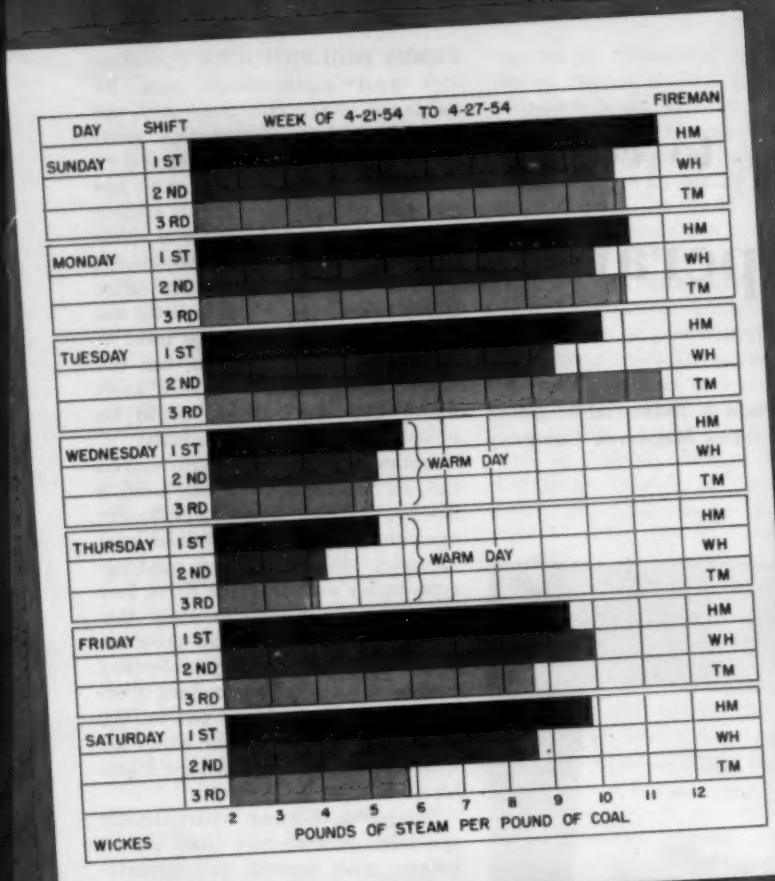


Fig. 2—Record of each shift's performance is plotted on chart to encourage competition between shifts. Results of program show up in better performance.

calculations. To get this without a scale, we measured the coal delivery rate of the screw conveyor feeding the stoker hopper in pounds per second. An integrating timer is connected to the conveyor motor starter. Timer supplies operating time of conveyor, and product of time and rate of delivery gives approximate coal consumption.

Provision is made for recording the integrated time reading at start of the shift, as well as time of day at which readings were taken. End of shift readings are taken as starting readings for the next shift. By reference to a chart, the amount of coal consumed for any given time interval of conveyor operation can be determined.

Integrator readings on the air-flow-steamflow recording instrument indicate number of pounds of steam produced. Pounds of steam obtained per pound of coal is a direct measure of efficiency. All required data for this figure are available, and a simple division is all that is required.

A record of each shift's performance is plotted on a bar chart in the powerhouse to encourage competition between our operators and thereby achieve efficient operation (see Fig. 2).

An automatic continuous blowdown meter is installed on our main water tube boiler, and its adjustment is indicated on chart as the Madden blowdown setting number. By referring the setting number to a related chart, gallons or pounds of blowdown water per hour being drawn out of the boiler can be determined. This is necessary information to arrive at net pounds of steam produced.

Space for remarks is provided so that firemen can record any unusual happenings that occur during their operating shift. They are required to record any unusual occurrence, even though it may seem very minor in nature.

If an installation is not equipped with an integrating steamflow meter, another approach to the problem would be to meter boiler feedwater. If this is not practical, a simple Veeder-Root counter could be installed on the boiler feedwater pump, providing it is of the piston type. With a little experimentation, gallons of water delivered per stroke of the pump can be determined, and from this, amount of feedwater delivered into the boiler. Obviously, a boiler will produce steam in direct relationship to amount of feedwater, less blowdown water and steam.

Wanted to check firemen

When installing our new boiler, we decided to get an airflow-steamflow meter to check the firemen on their operation of the boiler and to observe any variations that occurred. This meter provides a 24-hour record of airflow, steamflow, and stack temperature. In addition, it provides an integrated steamflow reading. These are three vital readings and from them one can approximate boiler efficiency, providing some past experience with the boiler is available as background reference.

Fig. 3 shows a chart obtained from this instrument in a 24-hour period. Unidentified major variations in airflow are caused by ash removal, at which time blast gates must be closed and ashpit doors opened. Firemen are required to record reasons for any other major variations on the chart.

To assist firemen in securing efficient operation of the major boiler unit, they have been provided with a portable CO_2 meter. Every time a reading is taken, they must record reading and all major adjustments affecting the reading directly on the chart. These adjustments include automatic control system dial set-

ting (which affects amount of airflow) and stoker feed setting. Time of the reading is indicated by location of an arrow that can be observed opposite each recorded CO_2 reading in Fig. 3.

Control system setting and stoker feed setting both affect CO_2, and by reading these as well as CO_2 settings we have accumulated data for analysis. It is anticipated that these settings can eventually be specified for various steam loads.

Investment in a CO_2 meter is very worthwhile for any boilerhouse installation. Various kinds and models can be obtained for well under $200.

Foundation for any good maintenance program is proper lubrication. We have accordingly tried to insure proper lubrication by developing a lubrication schedule. This not only indicates when items are to be lubricated, but also provides for recording initials of the man performing the task. Our lubrication schedule is illustrated in Fig. 3. It covers those items essentially related to the water tube boiler. It will be seen that there are some items requiring daily lubrication, some weekly, and others monthly. Where special grease is required, it is indicated on the lubrication schedule.

As a further aid to the firemen in properly operating the boiler, an inspection schedule similar to the lubrication schedule was developed (See Fig. 3).

Similar inspection and lubrication schedules were developed for our fire tube boilers, but these need not be completed unless at least one boiler is in operation.

As part of good operating procedure, the boilerhouse and its equipment must be kept in a clean condition. It is also necessary to clean strainers, brush out draft lines, and blow down liquid lines. To insure that such items are properly handled, a third chart was developed (Fig. 3), which provides for weekly or monthly attention to the items listed.

Our experience with control charts and schedules has proved their worth in fewer breakdowns and higher operating efficiency. It is reflected by a lower cost per pound of steam. A similar approach can be used on almost any boiler installation, even a small one.

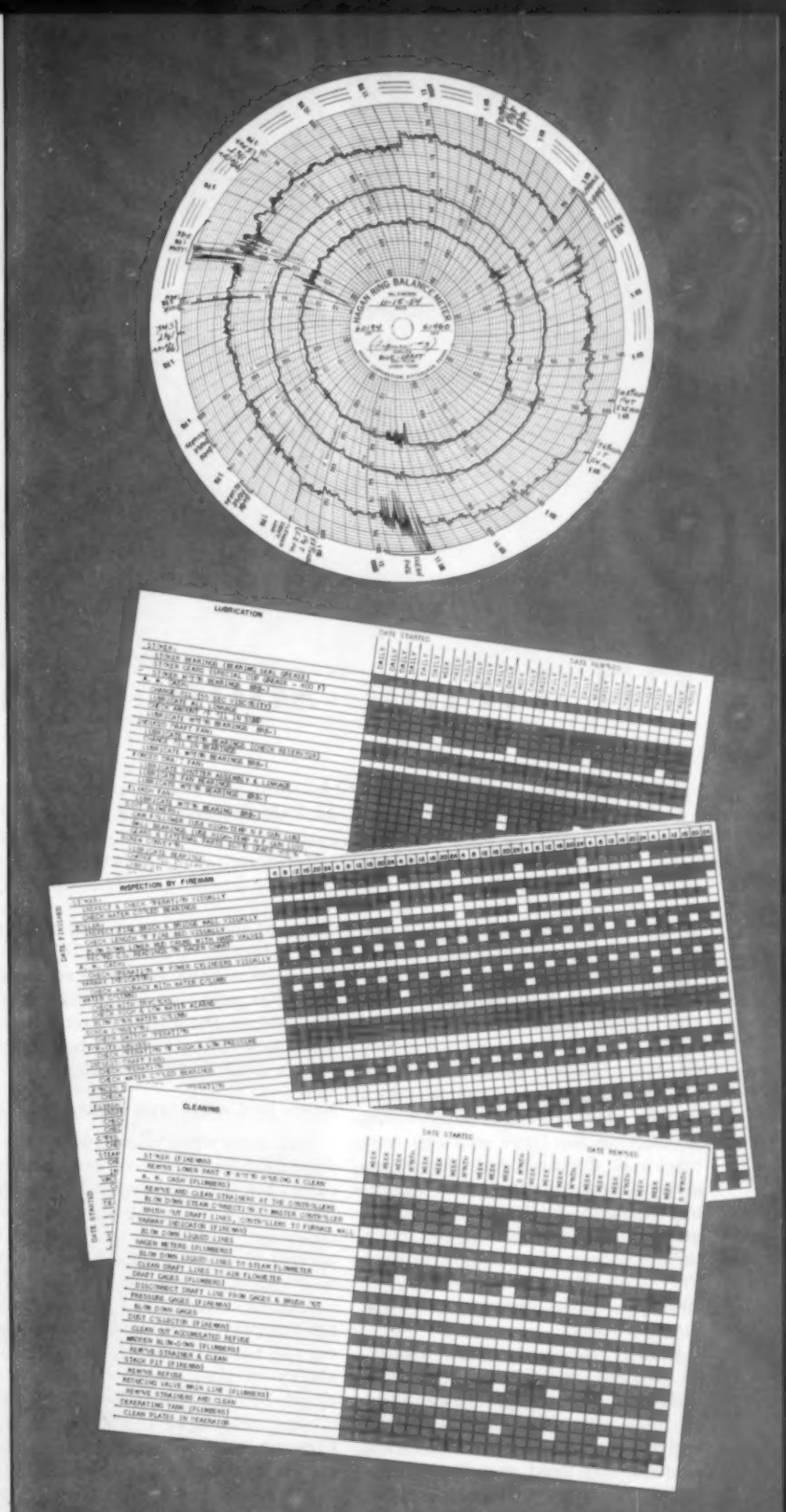
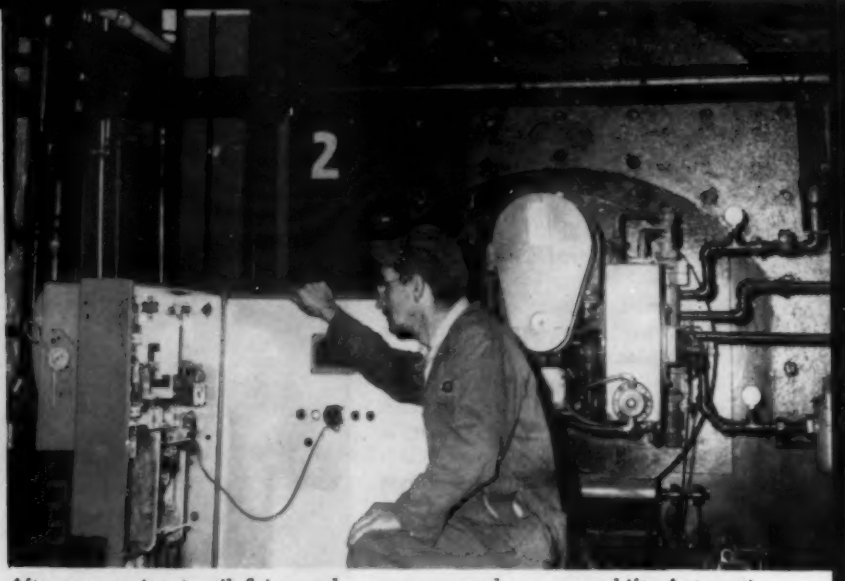


Fig. 3—CO_2 is recorded on airflow-steamflow chart (top), with reasons for major variations. Other charts check maintenance.

Before conversion, three men "sweated out" each shift firing three boilers.



After conversion to oil firing, only one man works on one shift. Automatic controls run boiler room around the clock, with occasional checks by police.

Oil firing soon paid for itself

JOHN ANTHONY
Plant Engineer, Aircraft Division,
Twin Coach Company

BOILER ROOM obsolescence too often goes unnoticed until rising production requirements become so great that the boilers just can't keep pace. Management at Twin Coach Company, Aircraft Division, began to study plant power requirements several years ago in view of continually rising production for large military contracts. It decided that the steam generating equipment was becoming obsolete. Boilers were inadequate, and it was costing too much to keep them in operation around the clock for the larger payroll and three shifts necessary to keep up production.

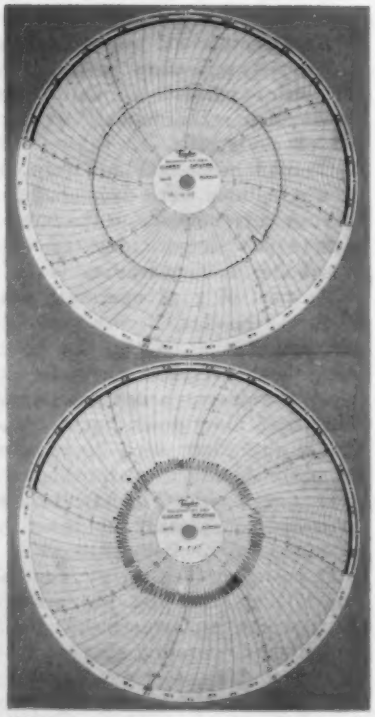
Boiler efficiencies were around 65 percent and 12 men, in four shifts of 3 men each, were required to look after them. Three HRT boilers, rated at 214 hp each, were continuously fired at full capacity, so there was no provision for maintenance during the winter.

We decided to convert the boilers to oil firing because this would greatly reduce the labor force necessary to look after the boilers. A great deal of space tied up for coal storage, including 16,000-sq ft indoor storage, would be released for other purposes. Oil firing would also reduce the smoke coming from our stack. The township has strict smoke abatement legislation.

Knew just what was wanted

Explicit specifications were drawn up for the conversion, which called for fully automatic modulating controls with individual burner capacities of 100 gph of No. 6 fuel oil. No. 6 oil was chosen for three reasons—it is cheaper, has a constant Btu content, and is always in good supply in this area. Although we had had no difficulty with availability of coal, it was costing us about $9.75 a ton, whereas No. 6 oil cost was 9.25¢ per gallon. Iron Fireman controls were chosen because they are fully modulating, they are competitively priced, and local service is particularly good.

Fuel oil is preheated in a 20,000 gallon storage tank, buried outside the plant. An Edwin Wiegand electric circulating water heating



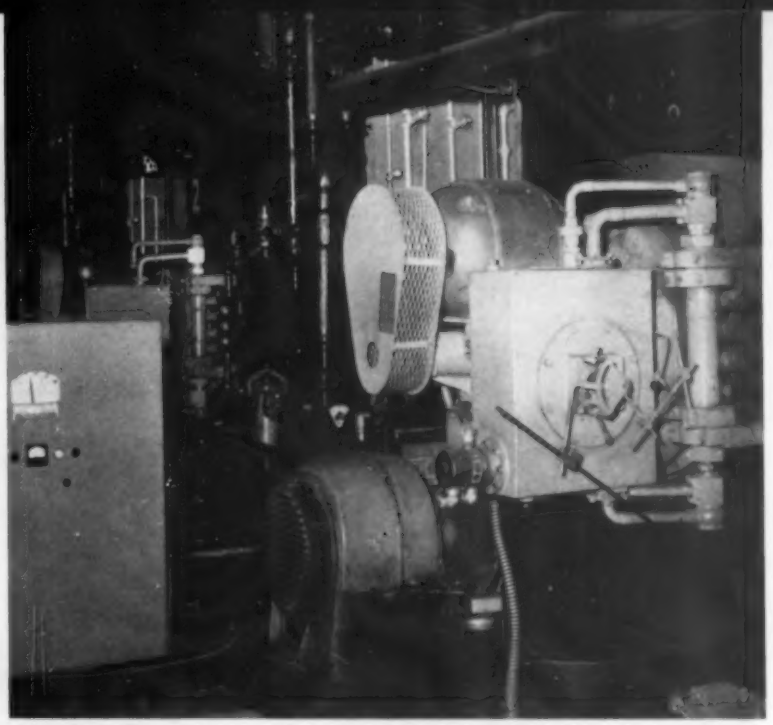
More constant steam pressure is only one advantage gained from conversion.

system keeps temperature between 128 and 140 F. A Ross steam heat exchanger then heats the oil to firing temperature of 175 to 180 F. A Wiegand electric standby heater was also installed for use in the event that steam would not be available. Controls for these heating units are by Clark. Oil ignition is by General Electric, and the starting switch is by Cutler-Hammer with a Square D main fuse disconnector. Water control and safety devices are by McDonnell & Miller and motorized valves by Minneapolis-Honeywell.

Draft controls are by the Cleveland Fuel Equipment Company and induced draft blowers by New York Blower.

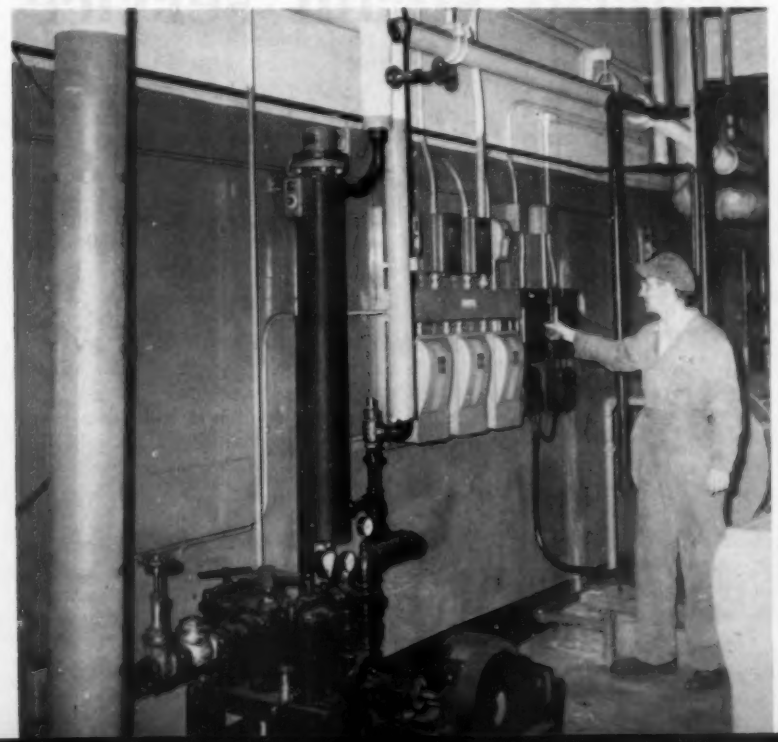
Most important factor about this conversion is that the cost will be completely amortized within two years through reduced maintenance and labor costs. Once the $29,000 cost has been paid off, the price of fuel oil can increase to about 15¢ per gallon without the cost of operation being more than it was with coal firing.

Now, only one man is required instead of the 12 formerly employed in the boiler room. He has fewer duties to perform, and it has been found that he can competently look after the three boilers in a 40-hour week. In working hours when this fireman is not on duty, a regular inspection schedule is maintained by plant electric staff and also by our security police. So far, no emergencies have occurred where the fireman had to be called from home. Since the conversion, our boiler efficiencies have increased to about 87 percent—in fact one unit is now kept as a standby except in extremely cold weather or during unusually heavy production schedules.



Controls for each boiler are housed in dust-tight panels. Boiler room is now a pleasant workplace, and coal storage area has been freed for other uses.

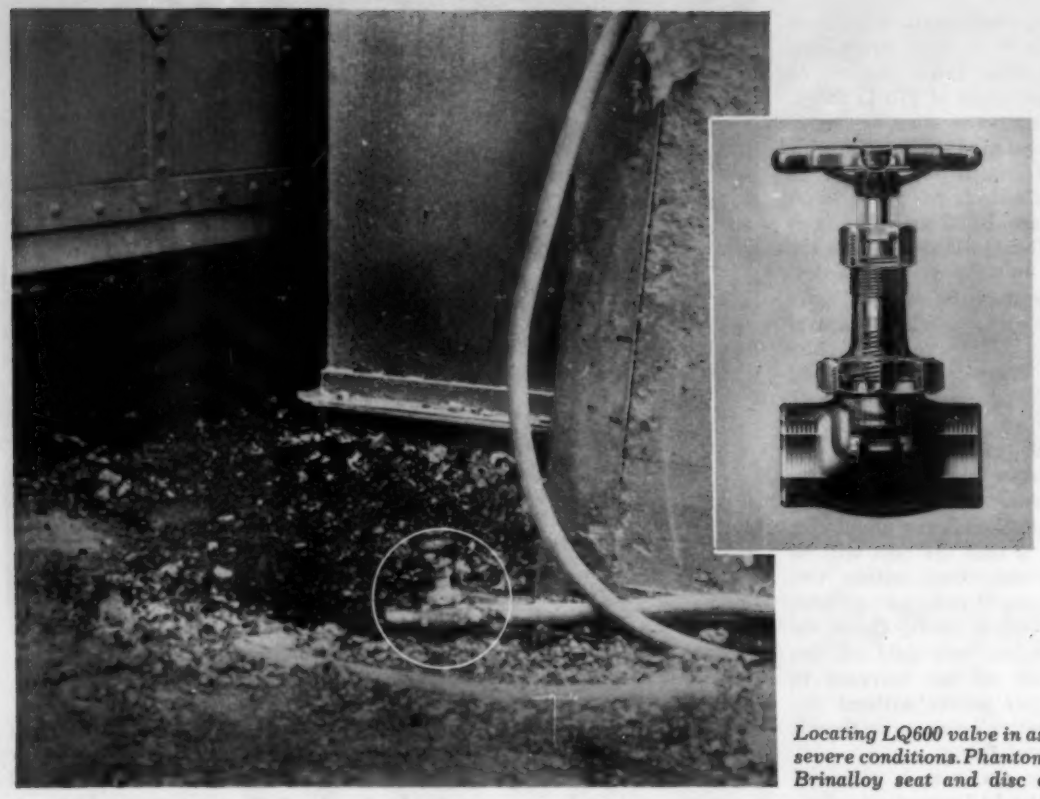
Oil is preheated in outside storage tank by electric water circulating system. Steam heat exchanger with electric standby then heats it to firing temperature.



There are several other benefits from this steam power changeover. Our boiler room is a much more pleasant work place nowadays. Coal bunker and storage area has been given over to other plant equipment and parts storage. Fully automatic controls give more foolproof operation than we ever attained by coal firing. More constant steam pressure is available in the plant than before. Our smokestack now gives off only a slight haze.

Another big saving is being made on the boiler refractory. Before, refractories within the boiler furnaces had to be patched up or replaced every two years or so, but it now looks as though the present refractory will last for at least 10 years.

Management is very proud of the conversion, since it now has a showplace boiler plant that is operating efficiently at greatly reduced cost, and has provision for coping with future expansion.



Locating LQ600 valve in ash pit adds to severe conditions. Phantom view shows Brinalloy seat and disc construction.

New valve for general steam service

HAVILAND F. REVES
Industrial Consultant

INCREASED VALVE LIFE under severe service use has been proved by the Wyandotte Chemical Corporation's latest tests. Performance of a newly developed valve that has exceptionally durable disc and seat characteristics is their secret of success.

Installation of the LQ600 Lunkenheimer valve was one of some 100 test installations made. A new patented seating material called Brinalloy is used in this valve. Brinalloy not only has high Brinell hardness (600 Brinell seat and disc) throughout, but also has amazing wear-resistant properties. Located at the base of the ash tower, the valve is in a steam line used for general purpose and maintenance service.

Other valves were unsatisfactory

Previous valve installations required replacement at intervals of six months or less. Many valves actually started to leak within two weeks after installation. Various types were tried, including most standard valve makes. This particular installation at the North Plant at Wyandotte, Mich., has been in operation about 20 years. Charles O. Moore, North Plant pipe shop superintendent, estimates that they have replaced some 50 valves during this time.

On March 27, 1952, a ¾-inch experimental Lunkenheimer LQ-600 valve with Brinalloy seat and disc was installed. It has served with complete satisfaction for over three years. This valve was made with 600 Brinell seat and disc, which was developed specifically to resist wear and corrosion of severe service.

High Brinell hardness itself is not the entire answer to erosion encountered in throttling service. This new seat and disc alloy is far

more resistant to wear and corrosion than 500-Brinell stainless steel—far outlasts case-hardened stainless steel exceeding 1000 Brinell.

New alloy is basis of design

This new and modern valve is designed around the seating alloy, and features many of the other Lunkenheimer "firsts."

Important problems inherent in the Wyandotte Chemical installation are twofold.

¶ Steam line is continuously being opened and closed during operating periods.

¶ Valve is commonly used throttled down to about half capacity when in use. These two conditions greatly increase valve wear.

In the words of Superintendent Charles O. Moore, "On a typical plant installation, like a boiler blowdown, you'd have less demanding service than here because the valve would be either full on or full off for a considerable period. Here it is throttled about half-open when in use, and cuts far more—this will happen even on a familiar water service gate valve. . . . This is not a dramatic use, but a very satisfactory one."

Ashes are taken from the furnaces to the ash tower by special ash cars on a rail system. A hoist at the tower elevates the car approximately 60 feet to the top. Ashes are then dumped, crushed, and processed into fine ash. They are gravity-fed into trucks from the tower and hauled away.

Steam line starts at the boilerhouse, and is buried for its entire length to end point at base of the ash tower. The valve is located below ground level in a hollowed-out area in the gravel and ash soil that covers this section. Stem projects above ground for control.

A 40-foot length of reinforced steam hose with metal nozzle is attached to the steam line downstream of the valve. Nominal ¾-in. steam line is used with no size reduction at the valve.

A variety of maintenance and operational tasks are simplified through use of this steam supply, such as:

¶ Removal of ice from tracks used by ash cars.

¶ Removal of ice from ash-car elevator hoist.

¶ Cleaning gears and machinery brought from any plant area.

¶ Supplying miscellaneous steam requirements of millwright shop.

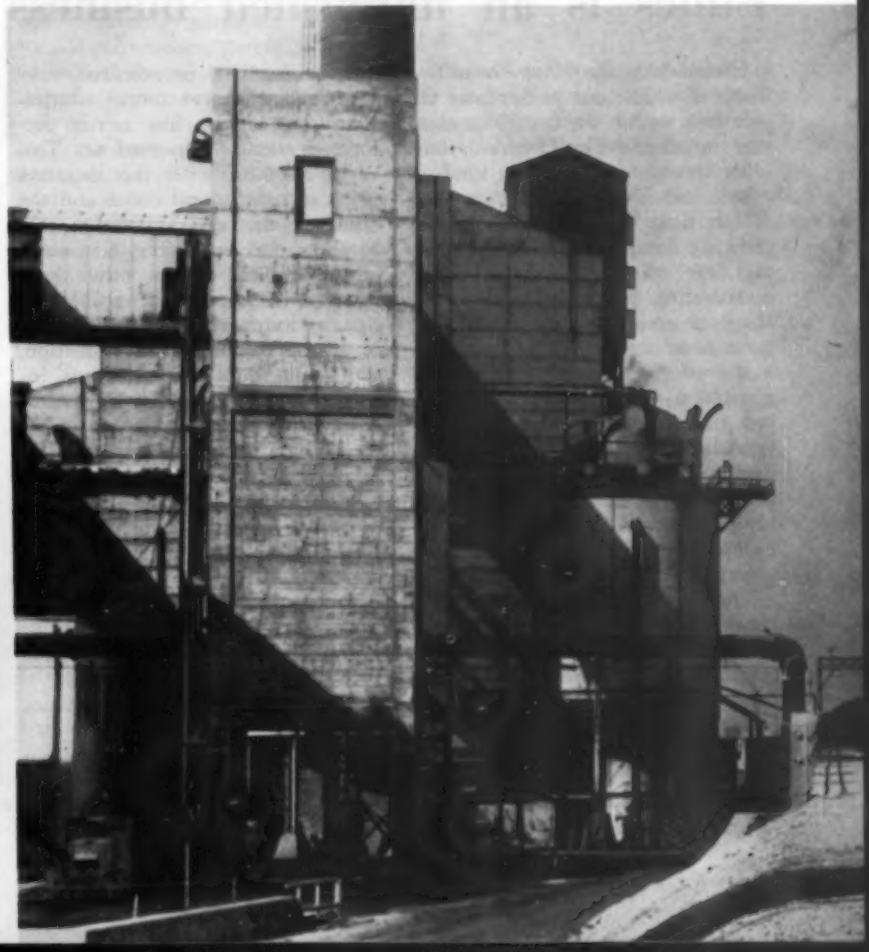
Usage obviously varies considerably from winter to summer. Cold weather usage is heaviest and most imperative. Mr. Moore estimates that the valve is used an average of 2 times a day in summer and 15 times a day in winter. Each use involves approximately six openings and closings of the valve. This means a rate of 90 cycles daily in winter and 12 cycles daily in summer. Year-round average is estimated at from 36 to 48 cycles daily.

Length of throttling time varies

Time during which valve is in throttling position depends upon seasonal requirements. Throttling use varies from two hours per day in summer to almost constant throttling use in winter. Throttled use is normally maintained with valve in half-open position. Additional use of steam line facilities by millwrights is unrecorded and cannot be included in estimates.

Valve inspection in the spring of 1955 proved that the LQ600 was

Location of ash tower at Wyandotte Chemical Corporation's North Plant. The valve and outside steam line are located at the left leg of the ash tower.



Charles O. Moore, piping superintendent, praises valve's performance.

giving satisfactory service. The bonnet was removed for the first time, and disc and seat were in satisfactory condition. At inspection time, the valve was still maintaining tight closure. It was reassembled and put in service again. At a later indefinite date, the valve was removed with other piping. A similar valve with *standard* seat and disc was installed. This valve showed a constant drip from the end of the nozzle after a short time: Valve replacement in the past was required because of rapid seat wear. In some instances, it was necessary to replace the entire valve. In other cases, it was necessary to replace the valve seat.

To further quote Mr. Moore: "The big factor was the labor involved in working on the valve. It cost $6 to $8 every time we had to make a change, for grinding in or whatever work was done. Anytime you do a job like this, you can figure on an hour lost for your fitter and helper."

Individual service records have not been kept on the many valves used in this installation. Maintenance of detailed service records is not practical in cases like this where constant piping changes are being made. This outdoor steam blowoff line is for general utility, and presents no significant piping problems.

Several advantages have become apparent during the long satisfactory valve performance:

1. Efficiency is improved. It is not necessary, as it frequently was in the past, to repair the valve and place the line in usable condition. Thus the special purpose uses—de-icing ash disposal equipment or cleaning some piece of equipment—were served with no lost time.

2. Scheduling piping work is facilitated. Plant shutdown time is decreased through decrease in number of valve replacements required in critical lines.

3. Safety is definitely improved. Utility steam hose hangs on wall rack. Employees walking near the valve could be burned by escaping steam if the valve were not functioning properly.

Experience at Wyandotte Chemicals shows that the LQ600 valve can be an efficiency, economy, and safety factor on any installation where valves are used in throttling service. Suggested installations are: siphon lines, ejector lines, and lines carrying flow of hot compound.

In summary, Mr. Moore says, "If all globe valves gave you as good service on an installation that is kept throttled down most of the time, we would have no cause for complaint."

Ethics is an unfinished business

Historically, there have been two kinds of ethics: one prescribing the relations within the family or clan; and the other dealing with relations with outsiders. The first kind of ethics has always been more unselfish than the second. With the growing complexity and lengthening time scales of production and distribution processes, caused by the ever greater divisions of labor, the size of the group to which the more unselfish kind of ethics applies has steadily increased. Every one now agrees that the "public" good must be given high weight in deciding what is right to do in any given case. Just who are included under the term "public" is still debated, but more people are being counted in all the time.

The larger the clan membership, the more unselfish the code of ethics for the individual must become. Thus, the breadth of application and the character of ethical codes are not fixed, but must change with the times.

In earlier times, a man who abstained from sin was called a "good" man. An ordinary person, not an engineer or scientist, may be held to deserve moral admiration, even if he has never performed a single generous act. This is in keeping with the negative spirit of most moral codes and the civil law, that are designed merely to prevent wrong-doing. Engineers and members of the other professions are expected to go beyond this, by living up to a positive code of ethics. In gaining an education, a lifetime debt to society is incurred, since the costs of a professional education are far greater than the tuition payments. The first duty of an educated man is to repay this debt, by unselfish service to the community and by contributing to the education of his juniors. . . .

Each right, each freedom, that has been won in the centuries of human progress has brought with it a corresponding duty. In modern terms, every manager has, or should have, a responsibility matching his authority. Thus, each profession has come to have its own ethical code, more precise in some respects than the ordinary moral code, and much more positive. Doctors are bound by the Hippocratic Oath, soldiers by military rules, the clergy by canon law, and the gentleman by his code of honor.

The engineering profession has a unique role in the modern world, because the engineer is the central figure in the complex procedures of mining, transporting, manufacturing, and building on which civilization rests. Nowadays, the engineer is called on to share in planning, managing, and promoting projects of every sort that depend on technical skill for their accomplishment. And, what large scale project nowadays does not call for technical skill? The engineer requires a broad knowledge of economics, of history, and of the forces that sway the minds of men, if he is to fill his expanding role. And, equally, he must behave more and more unselfishly in accord with his expanding role. This is why the subject of ethics is an unfinished business. . . . Philip L. Alger
Consulting Engineer
General Electric Company

Part II

Basic Laws, Circuits and Magnetism

G. C. BLALOCK
Professor of Electrical Engineering
Purdue University

Start right here and now to brush up on your electrical background. Each article in I&P's Electrical Refresher will cover some basic facet of electrical engineering that will help you do your job better. Single sets of the complete Electrical Refresher series will be available without charge. Send in your request now and we will hold it until the complete set is available. Quantity prices upon request.

VOLTAGE (or electromotive force) applied to a closed circuit, resistance set up by conductors in that circuit, and current flow through that circuit are related by *Ohm's Law*, written as

$$V = IR \qquad (1)$$

where V = volts
I = amperes
R = ohms.

Unit of resistance, the ohm, is therefore of such value that one volt applied to a circuit of unit resistance causes current flow of one ampere. Conversely, we can say that unit resistance with one ampere of current flowing through it results in a *voltage drop* of one volt.

Symbols E and e are used to represent electromotive force to distinguish between electromotive force of a power source and potential drop across a resistance. Capital E represents steady-state values. Lower case e represents instantaneous values. Symbols V and v are commonly used for the potential differences, potential drops, or voltage drops. Again, the capital letter indicates steady-state values.

Ohm's Law may be expressed in terms of electromotive force or potential drop. Electromotive force may exist without current flow but Ohm's Law applies only when current flows. It is used therefore, more often in referring to potential difference or voltage drop between two points in a circuit through which current is flowing.

Ohm's Law provides convenient means of determining resistance of a circuit. With measured values of V and I, resistance may be calculated as

$$R = \frac{V}{I} \qquad (2)$$

EXAMPLE: Heating element of an electric heating device has a measured current value of 6 amperes current flow when 120 volts is applied to its terminals. What is the resistance of this heating element?

SOLUTION:

$$R = \frac{V}{I} = \frac{120}{6} = 20 \text{ ohms}$$

Likewise, current may be calculated when voltage and resistance are known. Voltage may be calculated for a desired current through a known resistance.

Ammeter coils inject some resistance when placed in a circuit for measuring current. Likewise, voltmeters draw some current for their own operation when placed across a circuit for measuring voltage drop. For accurate measurements (such as resistance determinations by the foregoing potential-drop method), therefore, these errors introduced by the measuring instruments should be subtracted or minimized.

Consider the two circuit diagrams of Fig. 1. Resistance of voltmeters is usually in hundreds or thou-

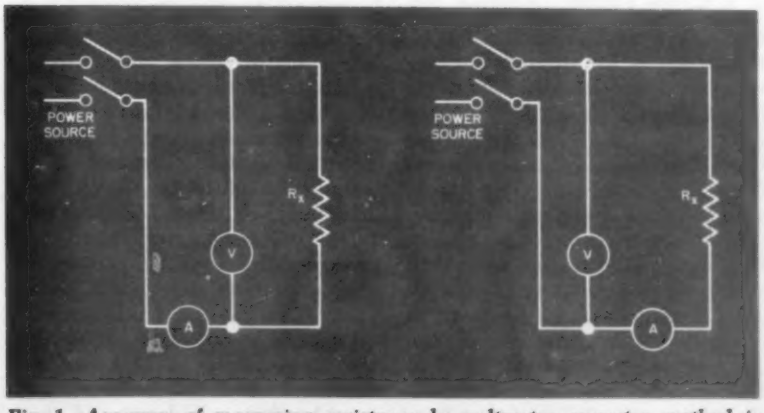


Fig. 1—Accuracy of measuring resistance by voltmeter-ammeter method is affected by relative positions of the meters when precision is demanded.

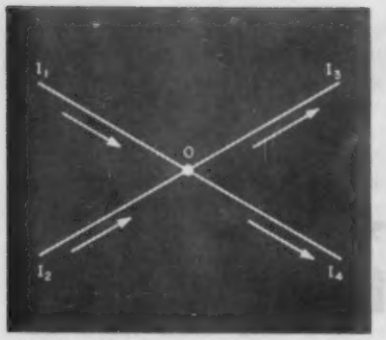


Fig. 2—Algebraic sum of currents flowing into any junction is zero.

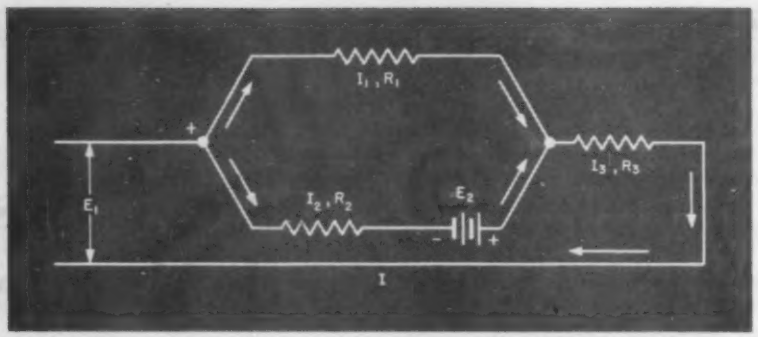


Fig. 3—Applying Kirchhoff's Second Law to this simple circuit, current flows, electromotive forces, and potential drops are assigned polarities.

sands of ohms. Resistance of ammeters is usually hundredths or thousandths of an ohm. Diagram (a) shows preferred setup for measurement of *low* resistances carrying comparatively high currents. Diagram (b) shows preferred setup for measurement of *high* resistances carrying comparatively low currents. If instrument resistances are known and accuracy requires it, errors introduced by instruments can, of course, be calculated and subtracted.

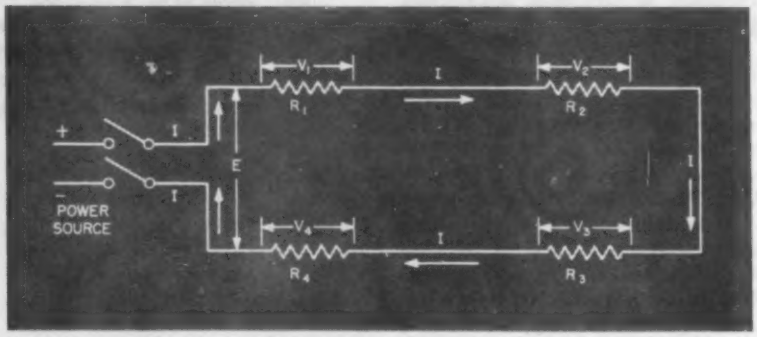


Fig. 4—In a series circuit, the current, I, must flow through all load elements so that $E = I(R_1 + R_2 + R_3 + R_4 + \ldots)$ by Ohm's and Kirchhoff's Laws.

Kirchhoff's Laws

Following Ohm's Law, the following two laws are of major importance.

KIRCHHOFF'S FIRST LAW: The *algebraic* sum of the currents at *any* junction of conductors is equal to zero; or, the total current flowing *toward* a junction must equal the total current flowing *away* from the junction.

KIRCHHOFF'S SECOND LAW: The algebraic sum of the electromotive forces and potential drops around a closed circuit is equal to zero; or, in any network of conductors the potential difference existing between two points is equal to the *algebraic* sum of the electromotive forces and potential drops by *any* path between the two points.

Kirchhoff's First Law means that there can be no storage of electricity at a given point. Referring to Fig. 2, I_1 and I_2 are represented as flowing toward junction 0. I_3 and I_4 flow away from it. Thus, calling arriving currents positive and departing currents negative,

$I_1 + I_2 - I_3 - I_4 = 0$ or

$I_1 + I_2 = I_3 + I_4$.

Thus, if any three of the currents are known, the fourth is readily calculated.

Kirchhoff's Second Law means that if a start is made from a given point in a network and any unbroken path is followed back to it, upgrade or downgrade with reference to potential, the starting potential will have been regained when the starting point is reached. If + signs are placed before quantities representing potential *rise* and — signs before quantities representing potential *drop*, then following the circuit *in the direction of current flow* via resistances implies potential drops. These values will be preceded by — signs. Going through resistances against current flow implies potential rise. These values should be given + signs.

Likewise, a source of electromotive force met in tracing the circuit will receive a negative sign if its polarity is met against the direction of current flow through the circuit—representing potential loss. Positive sign is given to a source of electromotive forces if its polarity is traced with the direction of passage through the circuit—thus representing potential gain. Thus in Fig. 3:

$$E_1 - I_1R_1 - I_2R_3 = 0$$

or $E_1 = I_1R_1 + I_2R_3$

also $E_1 - I_2R_2 + E_2 - I_2R_3 = 0$

or $E_1 + E_2 = I_2R_2 + I_2R_3$

Series circuits

Any number of load units may be so connected that the same current must pass through all units in series, as shown in Fig. 4.

Ohm's Law will then apply to each unit or to the entire circuit. From this fact and consideration of Kirchhoff's Second Law, we may see that the sum of the individual potential, or IR, drops around the circuit will add up to the total applied voltage. If the circuit contains supplementary sources of electromotive force, in addition to resistance units, Kirchhoff's Second Law (The Law of Voltages) may be applied as indicated before. Or, the *algebraic resultant* value and direction of electromotive force may be first calculated and then placed equal to the sum of the IR

drops around the circuit, as in the following instance.

EXAMPLE: Assume that resistances of the supplementary battery sources and of connecting wires in Fig. 5 are negligibly small. Determine the current that will flow through the circuit and the voltages appearing at the terminals of the different units, assuming the following values:

$E_1 = 125$ volts $\quad R_1 = 2$ ohms
$E_2 = 5$ volts $\quad R_2 = 4$ ohms
$E_3 = 10$ volts $\quad R_3 = 6$ ohms

Set up the following equation:

$$I = \frac{E_T}{R} = \frac{E_1 + E_2 - E_3}{R_1 + R_2 + R_3}$$
$$= \frac{125 + 5 - 10}{2 + 4 + 6} = \frac{120}{12}$$
$$= 10 \text{ amperes}$$

Following this, compute that

$V_1 = IR_1 = 10 \times 2 = 20$ volts
$V_2 = IR_2 = 10 \times 4 = 40$ volts
$V_3 = IR_3 = 10 \times 6 = 60$ volts
Total IR drop $= 120$ volts

We see that the net electromotive force of the curcuit is exactly balanced by all IR drops in the circuit.

Parallel circuits

Where, at a junction point, currents are free to follow more than one conductor-path to another common junction point, we consider Kirchhoff's and Ohm's Laws with the following conclusions:

- Voltage drop between any two points is the same following any of the parallel paths between them.
- Current entering a junction point divides between its branch-paths in inverse proportion to their resistances, assuming there is no supplementary source of electromotive force in the branch circuits.
- Total current leaving the second junction point is the sum of the branch-circuit currents arriving there.

Referring to Fig. 6, the above conclusions may be expressed in equation form as

$V = V_1 = I_1R_1 = V_2 = I_2R_2$
and
$I = I_1 + I_2$
Also, since

$$I_1 = \frac{V}{R_1}, \text{ and } I_2 = \frac{V}{R_2}$$
$$I = \frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2}$$

or

$$I = V\left(\frac{1}{R}\right) = V\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

from which

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

If, in Fig. 6, we assign values as follows:

$R_1 = 20$ ohms
$R_2 = 40$ ohms
$V = 120$ volts

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{20} + \frac{1}{40}$$
$$= \frac{3}{40}$$

or

$$R = \frac{40}{3} = 13\ 1/3 \text{ ohms}$$

$$I = \frac{V}{R} = \frac{120}{13\ 1/3} = 9 \text{ amperes}$$
$$I_1 = \frac{V}{R_1} = \frac{120}{20} = 6 \text{ amperes}$$
$$I_2 = \frac{V}{R_2} = \frac{120}{40} = 3 \text{ amperes}$$
$$I = 6 + 3 = 9 \text{ amperes}$$

Networks

Circuits other than power circuits (such as are used in radio, television, and other electronics circuits) may become much more complex than the series and parallel circuits just discussed. These

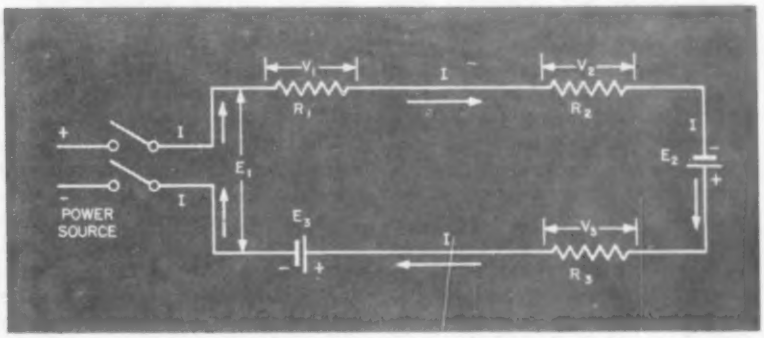


Fig. 5—Inserting electromotive forces into the circuit of Fig. 4 requires only assignment of correct polarities for solution of all circuit unknowns.

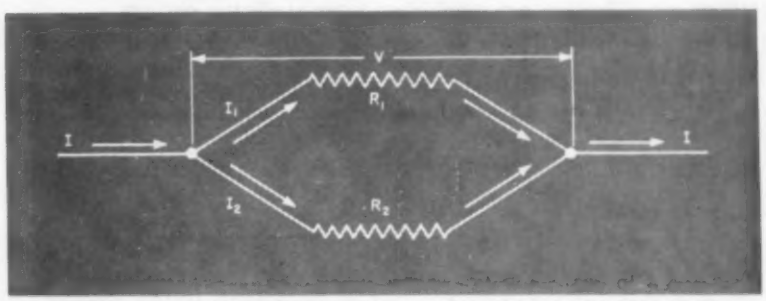


Fig. 6—Simple parallel circuit is solved with Ohm's and Kirchhoff's Laws, current I dividing into I_1 and I_2 in inverse ratio to resistances R_2 and R_1.

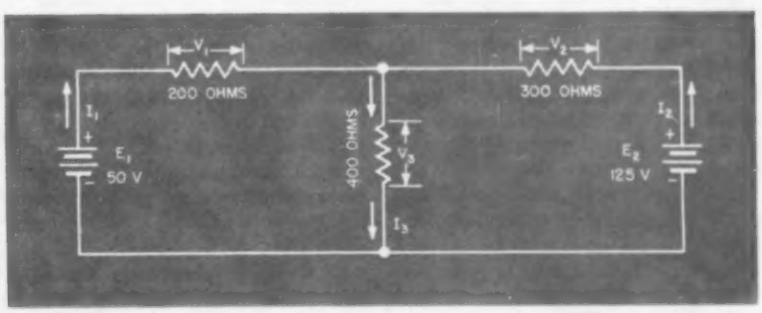


Fig. 7—Complex circuits involving loops can be solved with basic Ohm's and Kirchhoff's Laws plus other theorems though computations get involved.

are classed as *networks*. They are likely to vary greatly in complexity and to contain more than one source of electromotive force such as the simple network circuit of Fig. 7.

Kirchhoff's Laws may be applied to network problems by setting up simultaneous equations and solving for unknown voltages and currents. In setting up such equations, take care to apply Kirchhoff's First Law to a sufficient number of junctions to include every unknown current at least once. Apply the Kirchhoff's Second Law a sufficient number of times to include every branch of the network at least once.

Superposition Theorem is also convenient to apply sometimes. It may be stated as follows: Current flowing at any point (or voltage between any two points) in a network due to many electromotive forces is the algebraic sum of the currents (or voltages) at these points which *would exist* if each electromotive force is applied alone, temporarily replacing each of the other electromotive forces by a resistance equal to that of the temporarily removed electromotive force. Many other theorems and certain other procedures leading to circuit simplification are available to the electrical engineer.

Magnetism and magnetic circuits

Magnetism is closely associated with electricity. Its existence, in natural forms, was known and studied for a long period before its association with electricity was discovered. Magnetic properties are possessed by certain natural substances. These materials — principally iron, cobalt, and nickel in various alloys and compounds — can be strongly magnetized. These are known as *ferromagnetic* materials as distinguished from *paramagnetic* and *diamagnetic* materials, which can be magnetized slightly or not at all.

To assist in visualizing magnetic fields, the concept *lines of magnetic force* has been devised and generally accepted. These imaginary lines form *magnetic flux*, of which the magnetic field adjacent to a magnet is assumed to be composed. Unit line of force is called *maxwell*. We call 10^8 such lines a *weber*.

Electric currents form magnetic lines of force. When conductors are wound about a core, forming *electromagnets*, strength of magnetic field thus established will depend upon the number of turns of conductor about the core as well as the number of amperes passed through the conductor — thus giving the ampere-turn, or NI, as a unit of *magnetomotive force*. This is somewhat analagous to electromotive force in electric circuits.

If turns of a coil are wound upon an iron or steel core rather than upon a core of nonmagnetic material (such as wood), the same magnetomotive force produces a much larger amount of magnetic flux. Hence, iron or steel is said to be more permeable, or to have a lower value of *reluctance*, than nonmagnetic materials.

Reluctance of a magnetic path, like resistance in electric circuits, is directly proportional to length of path and inversely proportional to its cross section. Thus, a relationship similar to Ohm's Law may be set up for magnetic circuits as

$$\text{magnetic flux} = \frac{\text{magnetomotive force}}{\text{reluctance}} \quad (3)$$

or

$$\text{mmf} = \phi R \quad (4)$$

Using metric units,

$$R = L/A \text{ for nonmagnetic materials and} \quad (5)$$

$$R = L/A\mu \text{ for magnetic materials} \quad (6)$$

μ denotes permeability, or the ratio of relative ease with which a magnetic field is established in or through a given material as compared with the ease of setting up the same magnetic flux in an air path. Permeability is considered unity for air, and greater than unity for magnetic materials such as iron and steel.

Permeability of magnetic materials is not constant, but varies with flux density or degree of *saturation*. For low values of flux density, flux density is closely proportional to the magnetizing force. As flux density increases, it become less responsive to further magnetizing force, and the circuit is said to be approaching saturation.

Cost of insulation failure

REGARDLESS of whether it is composed of organic or nonorganic materials, all insulation deteriorates with service and time. Adverse conditions will, of course, accelerate the deterioration, but in any event when insulation is found to be dry, brittle, and excessively deteriorated, reinsulation should be contemplated as it will be merely a matter of time before a major breakdown occurs.

A rotor of a 2200-volt ac motor, used in a Midwestern billet mill, had survived 23 years of service without rewinding. In spite of its deteriorated state, the insulation was not replaced, and the motor was continued in service.

It had been running normally when a flash, accompanied by dark smoke startled the operator. After the motor was shut down for examination, it was found that the insulation had broken down, and allowed the windings to ground on the rotor iron. The flow of current burned a six-inch hole into the rotor. At the surface, the hole measured four inches in diameter.

Production was abruptly halted. It was necessary to restack the rotor iron and completely rewind the rotor, and meanwhile production losses mounted. On the basis of the deteriorated condition of the insulation on the rotor, a decision was made to also rewind the stator. Damages totalled $30,000.

. . . *The Locomotive*
Hartford Steam Boiler Inspection and Insurance Company

In brief . . . .

AIEE Winter General Meeting

ATTENDANCE AND session records were broken at the recent AIEE Winter General Meeting in New York. Some 500 papers on all aspects of electrical engineering and allied arts were presented in some 98 sessions attended by a grand total of 5000 engineers, scientists, and industrialists.

Fault protection in large buildings

W. Deans
I-T-E Circuit Breaker Co.
J. De Lellis
A. J. Bisson
Consolidated Edison Company of N. Y., Inc.

"The character and magnitude of load of many new commercial buildings have forced consideration of the use for distribution purposes of voltages in the vicinity of 265/460 volts. The large loads involved as a result of central air conditioning, high levels of illumination, increased use of business machines, and the reliability of service required for many-storied buildings justify the installation of multi-transformer network service. . . .

[We conclude that:]

"1) The characteristics of arcing faults are such that, as the system voltage becomes higher, the arc is more apt to persist. The fault current becomes a higher percentage of the available current as the voltage increases.

"2) Where the higher utilization voltage is used, careful consideration must be given to the prevention and interruption of electric faults.

"3) Where design considerations permit, the introduction of additional impedance in the wiring by use of high impedance circuits, additional length, or separate reactors will limit the short-circuit current to convenient levels.

"4) The available short-circuit current at the power source is relatively fixed by the requirements of a network designed to supply adequate voltage under normal and emergency conditions to large concentrated loads in multi-storied buildings, where multi-bank installations are located, as well as small remote loads via secondary mains.

"5) The characteristics of silver sand fuses permit the use of smaller rated conjunctional protective devices.

"6) All the necessary equipment for proper control of short-circuit current is presently available."

Pres. E. R. Needles, ASCE, gave Noble Prize to R. L. Bright, Westinghouse.

Electrical inspection of petrochemical plant construction

N. D. Casdorph
J. H. Wieting
Carbide & Carbon Chemicals Company

"The primary duties of the Electrical Inspection Group were to see that minimum standards for materials and workmanship were met. Design was not a primary function of the Inspection Group. However, the Electrical Inspector had to be capable of doing design work to rectify field conflicts and to detect any oversights that might have occurred. The Inspector is frequently the last man who can detect and remedy a situation which could result in loss of life, property damage, or costly shutdowns.

"It was found that the Inspector had to establish a definite routine in conducting his tests and inspections. Time was an important consideration and lack of planning would inevitably lead to omissions with time-consuming rechecks. Generally speaking, the Inspector operated between these limits: Should a particular test be omitted, the result could be injury or death to someone and/or possible damage to equipment; should unnecessary inspections be made, the eventual result would be increased construction costs and delayed completion. It was constantly necessary to guard against any inspections that were becoming nothing more than a mere ritual."

Solar energy . . . . supplemental energy source

Henry B. Sargent, President
American and Foreign Power Company

"The main drawback to solar energy until now has been the high cost of the equipment required to use it and the intermittent supply of this resource. Research centers the world over are looking for a cheap way to store energy, and widespread use of solar energy will greatly depend on our ability to develop this storage device. Once we can store energy cheaply and efficiently, I think that the major problem of using solar energy will have been solved. Then it may be possible to store heat during the

AIEE Winter General Meeting

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summer for use during the winter, and perhaps it will even be possible to store cold during the winter to increase cooling comfort during the summer. And incidentally, if our colleagues in solar research should develop such an energy storage device, I am sure that many of you would be glad to exploit it to save some of your slack-time generator output to apply to your peak loads. . . .

"As I have mentioned before, economic studies conducted by Stanford Research Institute indicated that water heating is already economical in many locations. It was also shown that solar power may cost, under favorable conditions today, as little as 10 cents per kilowatt-hour. These costs may go down shortly, and it would not be surprising if a considerable number of solar irrigation pumps were on the market within a year or so. The solar batteries which have been developed in this country by the Bell Telephone Laboratories, although fairly expensive, are already in use in communication equipment and will undoubtedly find many other special applications. Successful solar heating installations have been made, and continued improvement can be expected to make them economically attractive in many areas in a few years. Solar stoves and cookers work, and will find their proper practical place as this fact is widely realized.

"I firmly believe . . . . that mass production techniques once introduced in this field will appreciably reduce costs that have been reported to date in the fabrication of prototypes."

M. J. Kelly, Bell Telephone Labs, gets award from Pres M. D. Hooven, AIEE.

Economic comparison of steam-turbine vs motor-driven boiler feed pumps

A. G. Mellor
J. F. O'Mara
R. C. Muir
J. F. Ransom
General Electric Company

"Recently there has been considerable interest shown in utilizing steam turbines to drive boiler feed pumps. This interest is due to several factors among which are the following:

"1) The trend to larger generating units using higher steam pressures, which has resulted in much larger boiler feed pump power requirements.

"2) The development of boiler feed pumps operating at speeds above 3600 rpm. These high-speed pumps are more economical, particularly for the higher pressure units.

"3) The difficulty of designing an auxiliary power system to handle the very large amounts of pumping power required by large generating units operating at high steam pressures. . . .

[We have concluded that]

"1) For the range of main generator unit sizes and steam pressures considered in this study, turbine drives for boiler feed pumps cannot be justified on investment cost alone unless a single, full-sized turbine drive with no spares is considered.

"2) For the three types of comparisons made, [initial investment, evaluation of incremental station output, and net station heat rates] turbine drives were justified in all cases when the increased net output of the station was evaluated at the level used in this paper.

"3) It does not appear to be economical to install more than two turbine drives per generating unit since the installed cost of two full-sized turbine drives is about a stand-off with three half-sized turbine drives.

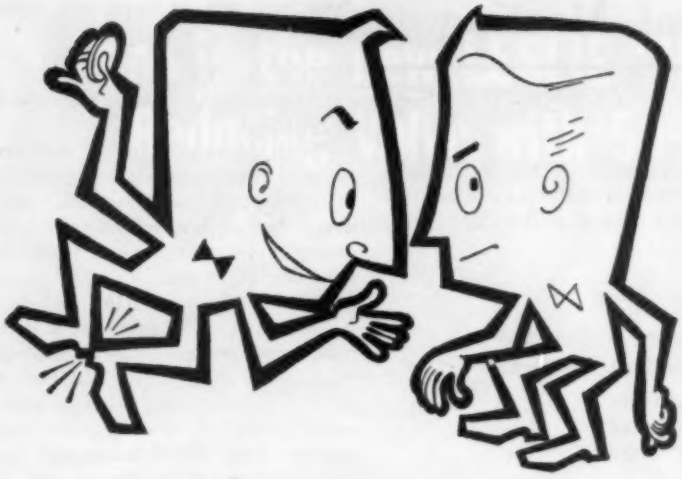
"4) As generator unit size and steam pressure increase, it appears that turbine drives become slightly more favorable from an investment cost point of view. At sizes and steam pressures beyond those considered in this study, the practical limit of conventional 4160-volt auxiliary power systems will be reached if motor-driven boiler feed pumps are used. At this point, there will be a sharp increase in the cost of motor drives and auxiliary equipment."

A modern dc network analyzer

C. H. Hoffman
Public Service Electric & Gas Co.
M. Lebenbaum
Airborne Instrument Lab., Inc.

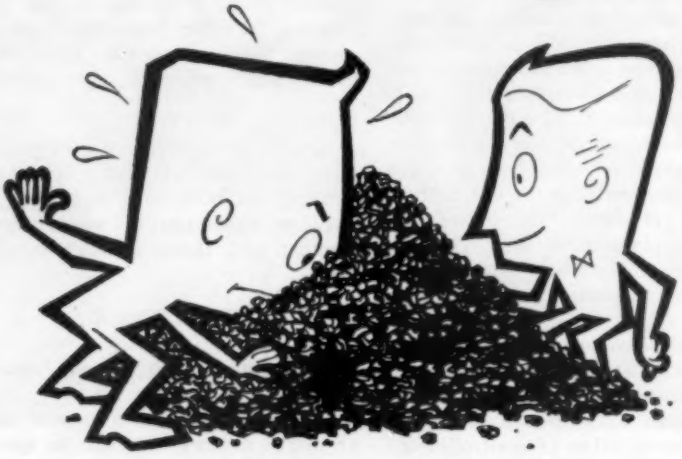
"Although dc network analyzers have had a long history, they continue to be useful. They are considerably less expensive than equivalent ac network analyzers, yet they are faster and simpler to use. For problems within their scope they give satisfactory answers. To replace an outmoded and inadequate utility-owned analyzer, a 300-line-unit analyzer has been constructed which incorporates a number of novel features. The availability of a new type of rugged microammeter made possible the adoption of a very low base current (0.2 milliamperes).

Although the low power level permitted the design to be compact, the power-handling capacity of the rheostats is such that they cannot accidentally be harmed. Half of the total numbers of units are arrayed within easy reach of each of the two operating positions. Short-circuit studies are speeded by a grounding panel directly adjacent



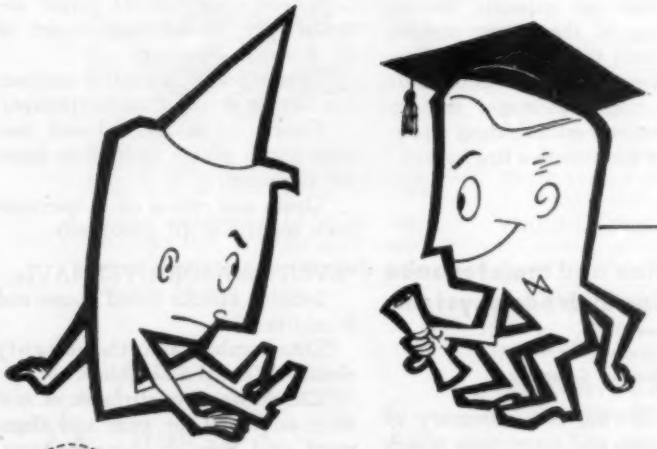
Look! I can buy coal for much less a ton than you're paying.

I used to buy that coal too, but it costs more per million BTU's with a whole lot more in hidden costs.



What do you mean by "hidden costs"?

That coal you're talking about is high in ash. So we were buying ashes at the coal price, paying freight on them from the mine, then paying to have them hauled away. Your "cheaper" coal clinkers; it smokes; it fouls the tubes. That means higher labor costs and higher maintenance. Now I pay more per ton and save thousands of dollars a year.



Coals produced on the C&O are tops in quality.

A C&O combustion engineer showed me why this grade of coal would work best in our type of installation and our experience has shown he was right. You'd better get some expert advice. It can save you money, too.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

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AIEE Winter General Meeting

. . . starts on page 59

to the instruments. Special grounding switches make it possible to measure transfer reactance without disturbing the plugging.

"The analyzer also includes other features which, though not new, have not previously been combined in a single dc network analyzer: dual instrumentation and power supplies, direct reading of circuit-breaker duties without plugging changes, 3-decade line units, highly stable constant-current loads, and a main power supply with essentially zero voltage regulation and unnoticeable long-term drift. Operation of the analyzer has been highly satisfactory, with an overall error of less than 1.5 percent.

Electric potential changes measure atmospheric contamination

C. R. Chapman
J. R. Eaton
Purdue University

"The development of an olfactory-electrical transducer is hampered by the general lack of knowledge about the quantity to be measured, but not hopelessly so. By way of analogy, it is easily conceivable that a man without any knowledge of the electromagnetic spectrum or of the workings of the human eye could still invent a photocell, perhaps by an accidental observation of the effect of light on an experimental rectifier. It was just such an incidental observation that suggested to one of the authors, in 1950, that the sensitivity of contact potential difference measurements to surface impurities might be used to provide a measure of the amount of odorous contamination in the atmosphere.

"Preliminary experiments showed that this was indeed the case. A number of odorous materials, when present in otherwise clean air in concentrations of only a few parts per million, were found to adsorb onto test surfaces in sufficient amounts to change the contact potential difference measurements by several millivolts. . . ."

Applying industrial controllers for safe operation

G. W. Heumann
General Electric Company

"A controller which is perfectly safe when installed in one plant may become a lethal hazard when installed in some other plant. It is the responsibility of the application engineer to select, from a number of standard or special designs, the one which will obtain the highest degree of protection under the specific plant conditions.

"From the point-of-view of safety the most important considerations are:

"a) Selection of enclosures to avoid fire hazard due to contamination of industrial atmosphere;

"b) Coordination of controller interrupting ability with the short-circuit capacity characteristic of the power system, to avoid the possibility of explosive failure of equipment that might endanger the operator and surrounding equipment and create a fire hazard."

Operation and maintenance of turbine hydrogen systems

S. C. Barton
W. H. M. Olsen
General Electric Company

The following is a summary of periodic tests and inspections which should be made of the hydrogen equipment:

"ONCE A DAY:

"Rotate handle on seal oil filter(s).

"On generators using the scavenging system, open drain valves in drip legs of scavenging lines and drain out any accumulated moisture.

"ONCE A WEEK:

"Reactivate generator gas dryer, if required.

"With generators using vacuum system, check automatic operation of emergency seal system; also, check operation of secondary emergency system if hydrogen pressure is under eight psi.

"With generators using scavenging system, check operation of each differential seal pressure regulating valve with other valve cut out of service. Also, one, check automatic operation of emergency seal system; two, check automatic operation of seal oil pumps on loss of bearing header pressure; three, check increase of gas pressure above eight psi.

"ONCE A MONTH:

"Check for presence of hydrogen, one, inside each generator bearing housing (at both ends of bearing; two, at discharge of vapor extractor; and, three, in turbine oil tank.

"EVERY THREE TO SIX MONTHS:

"Calibrate hydrogen gas analyzer.

"Check actual alarm points on all alarm devices of hydrogen system.

"Check operation of liquid detectors by introducing water or oil into the detectors.

"Grease points in control mechanism having grease fittings (pumps).

"Check oil in seal oil and vacuum-pump motor reduction gears (if provided).

"Drain and renew oil in vacuum-tank separator (if provided).

"EVERY MAJOR OVERHAUL:

"Include checks listed above and in addition:

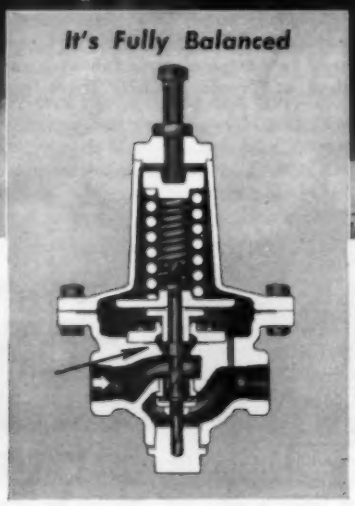
"Disassemble and thoroughly clean shaft seal assemblies.

"Check wearing surfaces of seal rings and shaft for wear and alignment and refinish if necessary, making sure that proper ring dimensions are maintained.

"Check float traps and seal oil regulating valves to make sure they are not sticking and will operate freely.

"Check and service pumps and motors."

Here is the new LESLIE "HI-FLO" Water Reducing Valve with 50% more capacity



Unique construction of "Hi-Flo" Reducing Valve. Note the small lower diaphragm that provides fully balanced, floating action.

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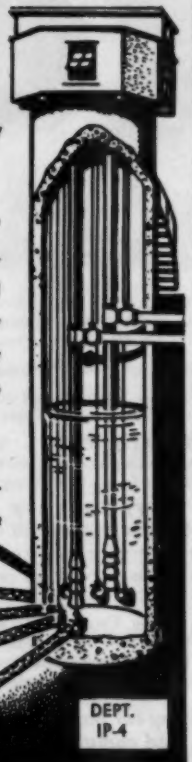

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Associates: Ranney Method Western Corporation

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ideas in action

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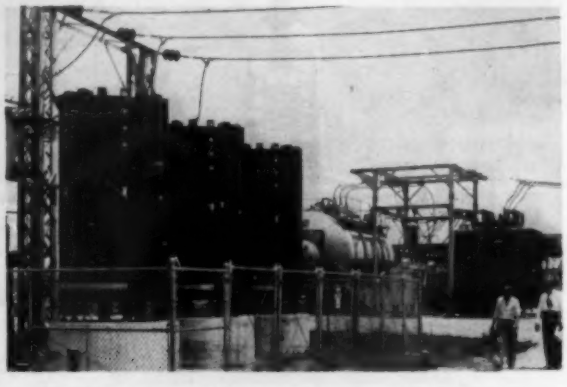
motor through V-belts. Pumps are rated 230 gpm at 960 rpm. Elevator was useful before new plant facilities started operating—it was used to lift loaded ready-mix concrete trucks and other building supplies to second floor during construction.

Checkoff labels for oil circuit breakers

Adhesive checkoff labels for oil circuit breaker maintenance are available free of charge from Allis-Chalmers Manufacturing Company. Similar to the checkoff stickers used on automobiles, circuit breaker forms provide a checkoff list for all standard tests, operation counter readings, and so one, for control, operator, and breaker. Labels are available for either pneumatic or "Pneu-Draulic" operators.

Voltage control equipment permits expansion

Specially designed current-limiting reactors and synchronous condensers, built by General Electric, permitted addition of two large electric furnaces on the Detroit Edison system at Trenton, Mich. Three reactors, each

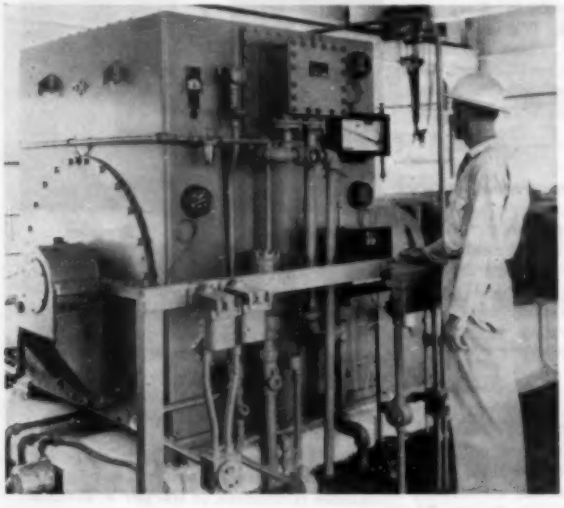


rated 12,500 kva, 6920 volts, 1820 amps, give 50 percent reactive drop in a three-phase, 75,000-kva, 24-kv circuit. Windings are aluminum, the most economical conducting material for this purpose. Synchronous condenser helps control voltage on a steel mill line. It is one of two similar units rated 50,000 kva which operate at 600 rpm.

TEIGF motors drive hydrogen compressors

Hydrogen compressors at Esso Standard Oil's Baltimore refinery are driven by three 350-hp, totally enclosed, inert-gas-filled motors. Motors were designed and built by Electric Machinery Mfg. Company for maximum protection against explosion of hydrogen due to sparking. Each motor has a practically gas-tight enclosure. Blind holes are used where bolts enter outside the enclosure. A machined surface fit, where bearing brackets attach to motor housing, eliminates need for gaskets. Continuous welds are used throughout. Oil-pressure gas

seals in bearings make them practically gas tight. Seals are virtually nonwearing and require no more attention than long-life sleeve bearings. A slight positive inert gas pressure is maintained inside enclosure. Motors are cooled by circulation of inert gas. Gas-to-water coolers are mounted near top of enclosures. Extra protection for motors is provided by special instruments and controls, which permit checking motor functioning at a glance.



These include inert gas pressure and temperature gages, relays—with alarms and shutdown contacts, rotating-type indicators for oil feed to bearings, oil level sight gages on oil reservoir and bearing housings, and purging valves for startup. Motors drive Ingersoll-Rand reciprocating compressors.

Electronic brain records power generation

New electronic brain is keeping a sharp watch on generators at the Sir Adam Beck-Niagara generating station No. 2. Machine keeps a swift and accurate record of some 540 operations. High-speed printing annunciator lists time, name, and operation (closing or opening) of the 540 points at the rate of 10 points per second. Recorder incorporates a memory device which permits delayed printing of operations that may occur simultaneously. Recorder operates at capacity for only a small fraction of the time, so methods of making use of its idle time are being considered.

Dual-fuel diesels save dollars

Savings resulting from use of low-cost gas fuel have paid for a $196,000 plant expansion at Wells, Minn., municipal power plant. Utility has also retired $45,000 in outstanding bonds and contributed $15,000 to the community in a two-year period. Earnings began to increase in 1950 when conversion from straight oil to dual-fuel operation was started. Expansion program included replacement of three 20-year-old straight oil diesels with a new Fairbanks-Morse 1920-hp opposed-piston dual-fuel engine. Partial basement was constructed for accessory equipment. In last eight months of 1954, plant generated 5,489,300 kw on 61,582,200 cu ft of gas and 76,860 gallons of oil—an average of 10.1 cu ft gas and .0104 gallon oil/kwh. Average fuel cost was 4.5 mills/kwh.

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names make news

. . . personalities from industry & power

Tuthill

Duesing

Tuthill Pump Company announces election of **James G. Tuthill** as president. Tuthill, a grandson of the company's founder, joined the company in July 1953. He is a graduate of the US Military Academy and was on active duty with the Regular Army for five years following graduation.

Hagan Corporation appoints **John E. Duesing** sales manager, Mechanical Division. Duesing was formerly district sales manager and has been associated with the company since 1939.

National Electric Products Corporation names **Francis J. O'Brien** works manager at Ambridge Plant. O'Brien joined National Electric in 1952 and was formerly manager of production and supervisor of the company's rocket division. He succeeds Leo F. Brown.

American Blower Corporation names **Herbert E. Barth** to newly created position of executive vice president. **Edwin W. Petersen** becomes vice president, sales. Barth joined the company in 1915 following graduation from the University of Kentucky. Petersen joined the company in 1923 following graduation from Iowa State University.

Liquidometer Corp. appoints engineering personnel. **Louis M. Campani** becomes chief administrative engineer. **Julius V. DiFranco** becomes chief electrical engineer. **P. Richard Rosenberg** becomes chief mechanical engineer. **Edgar Astrove** becomes administrative assistant. **Edward Chowske** becomes supervisor of Industrial Engineering Group.

Paulette

Bressler

Infilco Inc. announces retirement of **Preston Pew** after 31 years of service with the company. **George W. Paulette** succeeds Pew as manager of municipal sales division. Pew will continue as a consultant with the company on a part-time basis.

Goodyear Tire & Rubber Company announces retirement of **Harper V. Bressler,** assistant sales manager of Industrial Products Division. Bressler joined the company in 1919 and has served in many managerial sales capacities since 1931.

Eta Kappa Nu, honorary electrical engineering society, inducts three well-known engineers as Eminent Members in the society. Those honored were: **Harry Nyquist,** assistant director of system studies, **Bell Telephone Laboratories, Leon N. Brillouin,** director of electronic education, **International Business Machines,** and **William D. Coolidge,** X-ray consultant for **General Electric Company.**

Scholl

Daugherty

Allis-Chalmers Manufacturing Company elects officers. **Willis G. Scholl** becomes executive vice president. Scholl, formerly group vice president, is a veteran of over 20 years' service with the company.

Rockwell Manufacturing Company names **A. Clark Daugherty** assistant to president. Daugherty was formerly market research manager.

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Hot water fast

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PICK MANUFACTURING CO. Pick instantaneous hot water heaters are engineered for service. Write for booklet on how Pick heaters cut hot water costs.

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HENSLEY COMPANY. Continuous blowdown unit controls boiler water concentration automatically without heat loss. Write Dept. A for Free Blowdown Chart.

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SORGEL ELECTRIC CO. Higher interior distribution voltages and installation of dry-type transformers, indoors at load centers, give greater efficiency and economy. Write for free information.

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handy guide

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Complete burner requirements
Read page 72 and circle number 113
THE ENGINEER COMPANY. Enco burners for oil, gas, or tar offer complete flexibility for all plant requirements. Bulletin OB-53.

Tremendous coal tonnage
Read page 23 and circle number 141
SOUTHERN COAL COMPANY. Send for literature showing how you can save on coal. Mechanized recovery and vast transportation experience all help to give you better service for less cost.

Instruments and controls

Meet a new pump control
Read page 11 and circle number 114
MCDONNELL & MILLER, INC. New control does three jobs, singly or in combination: controls boiler feed pumps, provides low water fuel cut-off, and closes an electrical circuit for low water alarm.

Get what you set
Read page 25 and circle number 115
BUFFALO METER CO. Eliminate errors in batch mixing with Niagara automatic displacement meters—they deliver exactly what they are set for. Mail coupon for information.

Fast-acting controls protect boilers
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THE RELIANCE GAUGE COLUMN COMPANY. Water level alarms, fuel cut-outs, and pumps, are energized with the speed of electricity with Levalarms. Send for Bulletin D2.

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ESS INSTRUMNET COMPANY. Monitor smoke, turbidity, dusts, industrial gases, and color accurately with these dependable and rugged recorders, indicators, and controllers.

Lubrication

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THE TEXAS COMPANY. Tests on big diesel installations against other lubricating oils, prove the value of Ursa oil. Write for assistance on your lubrication problems.

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Maintenance items

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Read page 32 and circle number 123
THOMAS C. WILSON, INC. Tube expansion is our business. Check exclusive features of the Wilson Torq-Air-Matic, a new air-driven tube expander. Bulletin 55 gives details.

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Read page 70 and circle number 125
AIRETOOL MANUFACTURING COMPANY. Water powered tube cleaning motors are the perfect answer for plants where air and steam are not available. Send for literature that you should not miss.

Now you can expand small tubes
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THE GUSTAV WIEDEKE COMPANY. Tube expanders for rolling and flaring tubes in super-heater headers are now available. For tubes as small as ⅝-inch diameter. Send for bulletin.

Materials handling (bulk)

Bins with super strength
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Piping, tubing, and hose

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Get non-clog pump performance
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AMERICAN-MARSH PUMPS. Get full non-clog performance at no more than the cost of ordinary pumps. Handle liquids with solids up to three inches in diameter. Send for Bulletin 325-A.

Reducing valves with more capacity
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Use one-piece valves for high pressures
Read page 81 and circle number 132
REPUBLIC MANUFACTURING CO. One-piece stainless steel, forged-body valves can't leak or come apart. Suitable for 10,000 psi working pressure. Send for Catalog 654.

Outstanding for steam service
Read page 81 and circle number 133
JOHNSON CORPORATION. Direct-operated solenoid valves with stainless seats make light work of heavy-duty steam service.

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more powerful Airetool Water Driven Tube Cleaners

Always a leader, now Airetool comes to the front with newly designed, ball-bearing type tube cleaning motors that are water powered.

They are the perfect answer for plants where air and steam are not available or advisable for tube cleaning equipment . . . and are valuable tools in every industry where tube maintenance is a problem.

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EUROPEAN PLANT: Airetool Nederland, N.V., Vlaardingen, The Netherlands.

- "There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction."

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handy guide

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Valves and regulators

More dependable motor valve
Read page 85 and circle number 134
THE CHAPMAN VALVE MANUFACTURING COMPANY. Trouble-free control of valves and sluice gates assured with Chapman Motor Units. New Catalog 51 also available.

Water supply and treatment

Insure against water shortage
Read page 64 and circle number 135
RANNEY METHOD WATER SUPPLIES. Forget water shortage problems, without going to expense of filter plants and treatment stations. Send for information.

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HUNGERFORD & TERRY, INC. A complete line of water conditioning systems is available from H&T. All sizes, all capacities, manual or automatic. Send for bulletin.

Guaranteed water treatment
Read page 9 and circle number 137
THE NORTH AMERICAN MOGUL PRODUCTS COMPANY. Completely integrated water treatment service is guaranteed to get results. Send coupon for assistance on your scale problem.

Get assistance on water treatment
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W. H. & L. D. BETZ. There is no need to hire a special staff to engineer your water conditioning. Just let Betz look after it, and you can forget you had a problem.

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Read page 31 and circle number 139
COCHRANE CORPORATION. Hot lime zeolite treatment is extremely versatile. Equally effective on turbid surface supplies or clear well waters. Removes silica economically. Send for further information.

Do you want pure water
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ILLINOIS WATER TREATMENT CO. Most economical way to obtain pure water is often by de-ionization. Provides an effluent that is chemically equivalent to multiple-distilled water. Write for free advice.

free bulletins

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Air cleaning equipment

500-Series on dust and fume collectors

Exhaust fans for dust collecting and air handling are described in Catalog 1002-6. Includes complete performance tables and test curves. Plans and elevations of typical installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities of Norblo bag type, hydraulic type, and centrifugal dust collectors. THE NORTHERN BLOWER CO.

501-Improved electrostatic dust control

"Dust and Fume Control," 11-page Bulletin G406, tells of the improvements and refinements that have been made in electrostatic precipitation since the first Cottrell precipitator was erected. Also included are background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, Dualaire dust collector, and HoloFlite processor. WESTERN PRECIPITATION CORP.

Air conditioning, heating, ventilating

502-Sprayed coil dehumidifiers

Water dilution, high humidification, evaporative cooling, and size determination are among the pertinent factors relating to selection of sprayed coil dehumidifiers discussed in Bulletin 7827-H. Included are formulas, tables, curves for accurate selection, and a step-by-step example of how to select a dehumidifier for a given hypothetical application. Optional arrangements and related equipment are also discussed. Twenty pages. AMERICAN BLOWER CORPORATION.

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Boilers and boiler accessories

503-Heating with hot water?

Bulletin 923 contains an easy-to-understand discussion of the problems relevant to industrial hot-water heating. Schematic diagrams of typical closed and open storage-type hot-water systems are included. Presented in question-and-answer form, it discusses pertinent questions on all phases of hot-water heating. Fourteen pages. FRED H. SCHAUB ENGINEERING CO.

504-Boiler instrument handbook

Boiler instruments to cover every phase of operation from water treatment to dust removal are contained in Bulletin GSP-901. Illustrations and text are combined to make this bulletin a necessity for engineers interested in boiler and steam problems. Twenty-six pages. HAGAN CORPORATION.

505-Boiler setting and baffle data

More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design, in 20-page Bulletin BW-54. THE ENGINEER CO.

506-Answers to hot water problems

Answers to your hot water problems are given in Booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are thoroughly discussed and illustrated. PICK MANUFACTURING CO.

507-Condenser tube inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of four-page Leaflet 500. Tube cleaners, expanders, and maintenance tools are listed. THOMAS C. WILSON, INC.

508-Boiler instrumentation data

Modern power plant instruments and control systems are described with the aid of photographs and schematic drawings in Bulletin 55-605-83. Combustion instruments and panels are treated in detail. Twenty-four pages. THE HAYS CORPORATION.

509-Blowdown control chart

Determination of the rate of boiler blowdown and selection of a correctly sized heat exchanger are made possible with use of simplified Chart JPC, based on total dissolved solids in boiler water. Also given are recommendations for selection of blowdown equipment in accordance with normal operating conditions of boiler installation. HENSZEY CO.

511-Complete boiler data

Complete data and specifications on each of the models and sizes in the "S" series line of boilers are given in eight-page Booklet WT-8. Units discussed range in capacity from 10,800 to 50,000 lb/hr. Other power equipment made by this company is discussed briefly. WM. BROS BOILER & MFG. CO.

Building construction, materials

512-Mortar joints repaired simply

These seven simple steps for repairing worn or corroded mortar joints of brick or tile floors are presented in Bulletin E-37. Procedure involves use of non-shrink, Embeco premixed mortar. THE MASTER BUILDERS CO.

518-More for your lumber dollars

How to get more value for your lumber dollar is explained in this illustrated booklet. Classifications of softwood and hardwood lumber by trees, manufacture, use, size, and grade is thoroughly explained. A valuable booklet about man's most versatile material. Twenty-four pages. NATIONAL LUMBER MANUFACTURERS ASSOCIATION.

519-How to preserve masonry

Kinds of masonry, effects of water absorption from without and vapor migration from within, and methods of caulking and pointing prior to application of preservatives are thoroughly explored in "Masonry Preservation." Well illustrated with diagrams and photographs, the book is divided into 10 sections. It is based on information obtained from both laboratory and field experience. Sixteen pages. THE TREMCO MANUFACTURING COMPANY.

520-Special manual for grating

All information and data vital to the plant engineer are given in this manual that covers all types of grating, open steel floor armor, stair treads, vessel liners, bridge decking, and drain grates. It includes safe-load tables, panel width

free bulletins

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constant charts, tables on standard widths and types of steel stair treads, and types of grating anchors. Booklet makes a handy reference tool. Sixteen pages. KLEMP METAL GRATING CORPORATION.

Compressed air supply

521-Are you wasting air?

"A Better Air Power System," Folder 213A points out that power losses in compressed air lines are frequently as high as 30 to 50 percent. It describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. Six pages. INGERSOLL-RAND COMPANY.

522-Air compressor selection guide

Bulletin 36 is a comprehensive text for selecting the proper air compressor for your job. Includes a detailed engineering section and tables of computations to insure correct installation. Also contains descriptions, specifications, dimensional engineering drawings, and representative photographs of the complete line of single- and two-stage compressors. Other sections include information on continuous operating compressors, accessories, and controls. Forty-four pages. BRUNNER MANUFACTURING COMPANY.

523-Family-album compressor catalog

A family album showing all the compressors and centrifugal pumps manufactured by the company is presented in Bulletin 603. Thumbnail sketches and brief descriptions of each type with sources of further information are included. Six pages. PENNSYLVANIA PUMP AND COMPRESSOR COMPANY.

524-Pneumatic regulator handbook

How to select pressure and vacuum regulators, ratio relays, and system purge assemblies is told in Bulletin H-2. Dimensioned sectional views, typical installations, and complete descriptive information are included. It also contains list of bulletins giving detailed information on other valves. Eight pages. CONOFLOW CORPORATION.

Steam or mechanical atomizing...1 to 1000 gallons per hour

Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

EC 909

THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.

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Drafting methods, equipment

525-Simplify your drafting practices

Sample drawings of engineered parts and assemblies illustrate the eleven rules (from the use of word descriptions for simple parts to making freehand drawings wherever possible) for simplifying drafting practices. These simplified methods have shown that it is possible to cut the total number of hours required to complete a given volume of work by 40 to 50 percent. Thirty-six pages. AMERICAN MACHINE AND FOUNDRY COMPANY.

Electrical distribution

526-Power connectors technical data

Bulletin 38-E contains condensation of pertinent technical information on the use of power connectors. Included are 20 separate resistance and current carrying capacity tables for many materials and connector configurations. Formulas are shown that determine forces due to short-circuit current. Comparative linear expansion tables for aluminum, copper, and steels, are also included. Thirty-six pages. DELTA-STAR ELECTRIC DIVISION, H. K. PORTER COMPANY, INC.

527-Dry transformer developments

"Latest Developments in Dry-Type Transformers," seven-page Catalog 153-A, presents advantages of air-cooled units designed and constructed primarily for inside installations. SORGEL ELECTRIC COMPANY.

529-Correct that low power factor

Booklet 50B describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Twenty-seven pages. SPRAGUE ELECTRIC CO.

530-How to choose circuit breakers

Essential information on selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

531-Transformer connection diagrams

Diagrams and explanations of transformer power and lighting connections are offered in Bulletin CS-102. Common single-phase applications are covered. Also included are typical connections demonstrating the importance of open delta or wye hook-ups during emergencies when continuous service is necessary in spite of transformer failure. Eight pages. KUHLMAN ELECTRIC COMPANY.

Electrical utilization

533-Battery maintenance manual

Photographs, charts, tables, methods of repairs, maintenance, and salient points on theory of operation are contained in this manual. Also includes instructions covering repairs with regular or special tools; simplified testing methods including safety practices, acid handling precautions, and instructions on correct charging methods. Forty-eight pages. C & D Batteries, Inc.

536-Handy pocket charts

Charts for wire gauge and temperature conversion are available in a pocket-size Bulletin No. GEZ-1510. The bulletin is printed on durable plastic material in large easy-to-read type. General Electric Company.

Fuels and firing equipment

538-Industrial heating handbook

New handbook provides plant engineers with basic concepts of industrial heat processing and heat control. Pruned of technical language, the handbook goes from a discussion of heat-to-fuel cost comparisons to design elements. Common formulas used in calculating heat and oven requirements are included. Bulletin 555 is a refresher course in process heating, and is a must for all plant engineers. Twenty pages. Michigan Oven Company.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 67.

539-How to handle heavy fuel oils

"The Heating and Handling of Residual Fuel Oils," eight-page Bulletin 1601, covers heavy fuel oils for use in burners of boilers, furnaces, and processing equipment of industrial and commercial plants and buildings. Use of Preferred Ribbon Heat for heating piping lines is explained. Preferred Utilities Mfg. Corp.

540-Modern ways of burning coal

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. Bituminous Coal Institute.

541-Refuse and wood burning

Engineering data concerning spreader stokers installed to burn refuse or wood are contained in 24-page Booklet 505. Stationary, manual dumping, power dumping, and traveling grate installations having maximum capacities from 10,000 to 275,000 pound steam per hour are described. Detroit Stoker Co.

542-How to save money on fuel

How to short-circuit trouble, improve operation, and effect substantial savings in your plant are discussed in this bulletin. Lists 10 services that alert steam plant operators are using to effect maximum efficiency. Lists three major sources of hidden waste and loss, with comprehensive discussion of remedial measures. Includes reply card for obtaining information on 25 case histories. Four pages. Fuel Engineering Company of New York.

546-Stokers are more flexible

Stokers for bituminous coal and anthracite are explained in detail with many illustrations in Bulletin 553. Complete specifications and ratings are included. Photographs and drawings of side ash dumps are also given. Twelve pages. Canton Stoker Corporation.

549-New combustion sampling

Full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. Equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. Arnold O. Beckman Co., Inc.

Instruments and controls

543-How to select thermocouples

Comprehensive discussion of theory and uses of thermocouples is contained in Bulletins 1601, 2, 3, and 4. Thermocouple circuits and metals, immersion length, protecting tube, junctions, extension leads, and terminal connectors are discussed in detail. Recommended operating temperatures and resistance tables are included for most commonly-used thermocouples. Dimensional drawings show installation data for the proper measurement of liquid gas, and surface temperatures. Fourteen pages. Revere Corporation of America.

552-Instrument selection chart

How to select the proper temperature control instrument is explained in Bulletin G-20. Specifications, description of operation, plus methods of installing high-temperature alarms and cutouts are described. Electric and pneumatic types are included, with operating temperature ranges from subzero to 1800 F. Four pages. Burling Instrument Co.

579-Power-actuated controller

Tight closure, enduring accuracy, easy adjustment, low head loss, and long life are features of power-actuated rate-of-flow controller described in Bulletin 600-J9A. Contains installation diagrams and capacity tables for controllers from 4- to 30-inch diameter. Control system may be pneumatically, hydraulically, or electrically actuated. Four pages. Builders-Providence, Inc.

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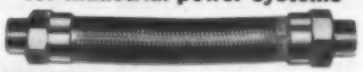

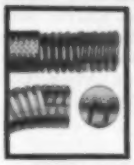

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544-How to select liquid-level control

Bulletin-1 discusses the factors to be considered in selecting a liquid-level control. It includes controls in types and sizes for handling practically any liquid, at any pressure and any temperature. Eight pages. MAGNETROL, INC.

545-Pneumatic systems handbook

Complete discussion of all phases of pneumatic control is contained in Bulletin 1120. Separate sections are devoted to transmission of pneumatic signals, cascade and ratio control, time replay, interconnected control systems, and tuning controllers to your needs. Charts, sectional diagrams, and typical installations are also included. Forty-six pages. MINNEAPOLIS-HONEYWELL REGULATOR CO., BROWN INSTRUMENT DIVISION.

547-Temperature and pressure control

Through years of experience in instrument design and manufacture, this company has developed a specialized line of equipment for recording and indicating temperature and pressure. Seven-page Bulletin G-158-A shows typical examples of such equipment. THE ELECTRIC AUTO-LITE CO., INSTRUMENT AND GAUGE DIV.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on page 67.

548-Electronic speed control manual

Illustrations and circuit diagrams describe in nontechnical simplified language the installation, performance, and maintenance of the basic Dynamatic electronic control. Also describes principles used to accomplish stepless speed control using an ac line as the power source. Sixteen pages. EATON MANUFACTURING COMPANY.

550-All-purpose water flow meters

Principles of operation of nutating-piston-type meters are explained in Bulletin 36. It contains illustrations and data of typical installations, trap strainers, air release valves, high-pressure meters, and meter registers for the measurement of most fluids. Twenty pages. BUFFALO METER CO.

551-Pocket-size thermocouple manual

Bulletin F 7255 is a convenient pocket-size reference manual for instrument men and engineers. Gives thermocouple temperature-millivolt equivalents. Temperatures are expressed on the International Temperature Scale of 1948, and electromotive force is expressed in absolute units. WHEELCO INSTRUMENT DIVISION, BARBER COLMAN COMPANY.

553-Positive mercury switch controls

Positive controls for pressure, vacuum, temperature, liquid level, and other variables, equipped exclusively with sealed mercury switches are described in Bulletin 26/Me. Four pages. THE MERCOID CORP.

554-New magnetic liquid-level control

Float-operated control using magnetic fields of force to open and close electrical switches is explained in Bulletin L-119. Operates at pressures up to 250 psig. It controls boiler feed pump from the boiler water level, provides a low-water fuel cutoff, and closes electrical circuit for alarm signal. Four pages. MCDONNELL & MILLER, INC.

Lighting

555-Fluorescent lamp handbook

"Fluorescent Lamps and Auxiliary Equipments," eight-page Technical Bulletin LS-101, gives complete data on the Circline, general line, Slimline, and rapid start lamps. Wiring diagrams, equipment for each type of lamp, and equipment for suppression of radio interference are included. Application Engineering Dept., Lamp Div., GENERAL ELECTRIC CO.

Lubrication

556-Lowdown on oil additives

Oil additives data on all types of fuels and lubricants from gear lubricant additives to viscosity index improvers is contained in this series of bulletins. Contains wealth of data on actual tests, laboratory tests, physical and chemical properties; plus recommendations for storage and transportation. A recommended addition to the technical library of all engineers. MONSANTO CHEMICAL COMPANY.

Maintenance items

557-Stainless steel data book

This new data book is a must for every engineer's library. Design and dimensional information on flange drilling templates, flange and ring-joint facings, stainless steel pipe, pipe threads, pressure-temperature ratings and conversion factors, resistance to fluid flow, hardness conversion tables, physical, and me-

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chanical properties of stainless steel are covered. Detailed materials selection chart for more than 300 corrosive solutions is included. Sixteen pages. COOPER ALLOY CORPORATION.

558-New electrodes for boiler repair

New line of low-alloy steel arc welding electrodes for boiler repairs and high pressure piping fabrication is contained in Bulletin 55CM. Electrodes eliminate weld cracking and reduce stress-relieving to a minimum. Preheat temperatures can be decreased to reasonable levels. THE CHAMPION RIVET COMPANY.

559-Rail spur maintenance handbook

Handbook D-3014 discusses maintenance of roadbeds, rails and joint bars. Discusses importance of ties, tie plates, rails, and spikes. Sixteen pages. L. B. FOSTER CO.

560-Handbook on specialty steels

Distinctive characteristics of a broad range of special purpose steels in terms of end use are given in this comprehensive handbook. It briefly summarizes tool and die steels, stainless steels, silicon and high-nickel electrical alloys, special purpose alloy steels, valve, heat-resisting and super-alloy steels, tubing and pipe, and fine wire. Will help to match the proper steel to the job. Thirty-two pages. THE CARPENTER STEEL COMPANY.

Materials handling (bulk)

561-Are you venting tanks properly?

How to vent flammable liquid-storage and process tanks for effective operation, fire protection, and low-cost maintenance is described in this bulletin. Illustrated sections are devoted to conservation-type, and nonconservation-type venting. Sections are devoted to flame arrester units, protective devices for fuel tanks on industrial equipment, and for loading and unloading tank cars. Twelve pages. THE PROTECTOSEAL COMPANY.

562-Conveyor belt slide rule kit

Two slide rules that cut the time required for designing a conveyor belt installation from three hours to ten minutes are now available. They are part of a conveyor belt construction kit. One is a horsepower calculator. The other is a carcass selector. They incorporate the engineering data contained in a 40-page conveyor belting notebook. UNITED STATES RUBBER COMPANY.

563-How to store bulk materials

Storage bins for bulk materials such as ashes, coal, coke, sand or lime are fully discussed in this bulletin. Contains tables of densities of flowable materials, capacities, description of wall construction, test data, and other relevant engineering data with many photographs. Twenty-nine pages. THE NEFF & FRY CO.

564-Multipurpose belt conveyors

Belt conveyors designed to solve your bulk materials handling problems are described in well-illustrated Bulletin 355. Cutaway sections illustrate lubrication and maintenance features, installation dimensions, and recommendations for spacing and guide rollers. Also lists accessories such as conveyor trippers, discharge spouts, belt cleaners, and impact carriers. Sixteen pages. STEPHENS-ADAMSON MFG. CO.

565-Versatile car switching units

Heavy-duty Trackmobile hauls, switches, and spots railroad cars. Operates on both paved road and track. Converts from road to rail wheels in only 90 seconds. Unit can develop as much as 12,800 pounds of draw-bar pull, and can double as a road tractor inside the plant when not in use switching railroad cars. Bulletin T-115. Sixteen pages. WHITING CORPORATION.

566-Wall chart for caustic safety

Handy wall chart that gives 37 specific suggestions for safe handling of solid, liquid, and flake caustic soda is based on accumulated plant experience. Printed in two colors on coated linen stock. Covers first aid measures, protective practices and equipment, dissolving and unloading procedures. There is space for emergency telephone numbers. DIAMOND ALKALI COMPANY.

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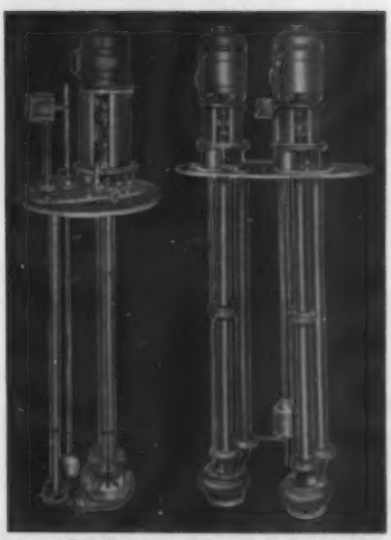

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. . . starts on page 71

Mechanical power transmission

567-Wire-rope strength tables

Tables of wire-rope breaking strengths are included with descriptions of standard Tru-Loc fittings and assemblies in Catalog TL 500. Reference charts, tables, and drawings are included with a section on special assemblies that can be made to order. Twenty-four pages. AMERICAN CHAIN & CABLE CO., INC.

568-How to select flexible couplings

Complete chart for easy selection of flexible couplings is contained in Bulletin 4100. Dimension drawings are shown with information applicable to more than 90 percent of all vertical or horizontal applications. Twenty-eight pages. THE FALK CORPORATION.

569-Texrope-drive selection tables

Handy multicolor tables for quick and easy selection of constant speed Texrope V-belt drives is now available. Booklet 20P40 also contains complete information on design features, basic V-belt drive principles and sheaves data. Seventy-four pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

Piping, tubing, and hose

570-Flexible joints for piping

Industrial applications highlighting the versatility and economy of the ball joint are described in illustrated Bulletin 215-B. Flexible ball, swing, swivel, and revolving movable joints are included for use in piping for power, process, heating, chemical, construction, and hydraulic service. Fifteen different sizes are illustrated from ¼ to 12 inches. One section is devoted to solving piping problems involving expansion-contraction, alignment and very slow rotation. Also included are do's and don'ts of maintenance and repair procedures. Twenty pages. BARCO MANUFACTURING CO.

571-How to remove piping deposits

"A Solution to the Problem of Deposits in Piping Systems," four-pages, describes three principal methods used in cleaning lines: chemical, pipe line pig, and jet moles. Case histories from industry are given to demonstrate where various methods should be used. DOWELL INC.

573-Stainless steel piping data

Engineers and designers concerned with stainless piping problems will find valuable data in six-page Bulletin TB-356. It outlines methods of bending and joining stainless pipe and discusses the problems of light wall versus heavy wall pipe with tables of dimensions and weights of various stainless pipe size schedules. THE BABCOCK & WILCOX CO.

575-Friction loss chart

Friction loss chart for flexible hose is offered in Bulletin 41-44 along with application and technical data. Accessories, installation data, and price lists are included. Eighteen pages. THE FLEXAUST COMPANY.

Pumping equipment

576-Stop those pump-seal leaks

Important features of unitary mechanical seals are described in Bulletin AD-151. Seals are designed for use on rotary shafts of boiler feed pumps, chemical pumps, oil refinery pumps, and digestor circulating pumps. Bulletin contains construction details of unitary mechanical seal, as well as recommendations for type of service. Specification form and installation sketch is also provided for obtaining additional special information. Twelve pages. THE GARLOCK PACKING COMPANY.

577-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON DIVISION, BORG-WARNER CORPORATION.

578-How to care for pumps

How to install and take care of power pumps is visually demonstrated in Bulletin G-2198. Explains details of foundations, suction conditions, piping support, cleaning, alignment, lubrication, and testing. Also includes maintenance information on initial and replacement packing, packing adjustment, common types of pump valves, and tips on trouble-shooting. A helpful guide on power pumps for engineers and operating men concerned with pump installation and operation. Twenty pages. WORTHINGTON CORPORATION.

581-Handbook of hydraulic tables

This comprehensive reference work is now available for engineers interested in pumping and piping problems. Bulletin 50 also contains data useful to all engineers. Twenty-eight pages. THE ALDRICH PUMP COMPANY.

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Refractories and insulation

582-Insulation, refractory handbook

Engineering data, formulas for calculating heat transmission, tables on heat losses from bare surfaces, and equivalent thicknesses of pipes are a part of the technical information contained in Bulletin IP-36A. Also includes descriptions of physical properties of the complete line of products. An excellent handbook containing information on all insulation and refractory problems. Fifty-two pages. JOHNS-MANVILLE.

583-How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. BABCOCK & WILCOX CO., REFRACTORIES DIV.

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Traps, strainers, and separators

584-Answers about clarifiers

Clarifier and thickener requirements for a wide range of capacities and solids removal loads are listed in Bulletin W-800B-S-6000B. Presented in question-and-answer form, bulletin explains need for and function of circular sedimentation basins, sludge scrapers, and central inlet wells. Sixteen pages. INFILCO INC.

Turbines

588-How steam turbines work

For a clear picture of how single-stage steam turbines operate, you will want Bulletin 1954C. Information on availability of various frames for single-stage applications, details on variable speed governors, and other features are included. Eight pages. WORTHINGTON CORP.

Valves and regulators

590-Read about control valves

Discussion of equipment for the control and regulation of steam, water, air, oil, and gas is contained in composite Bulletin C-50. This bulletin also contains descriptions of proper application for all pressure, flow, and liquid level controls. Four pages. MCALEAR MANUFACTURING COMPANY.

592-Accurate valve sizing manual

Comprehensive and easy-to-understand discussion of the importance of proper valve sizing is contained in Bulletin 120-2-55. Also contains formulae and nomographs for sizing valves to meet any conditions of steam, liquid, and gas flow. Additional tables of flow coefficients for the many configurations of diaphragm-control inner valves are also given. Twenty-four pages. BLACK, SIVALLS & BRYSON, INC.

595-Why not a solenoid valve?

If you use direct operated solenoid valves for automatic or remote flow control of liquids and steam up to 400 F, or of high viscosity liquids you will want to read 11-page Bulletin V-2. Normally closed, normally open, explosion-proof normally closed, and three way valves are shown. THE JOHNSON CORP.

596-Simple valve cross index

Valve users can easily obtain data on valves for a wide variety of applications by using the simplified cross index in 27-page Catalog 105. The most widely used cast and forged steel Edward globe and angle stop, nonreturn, check, gate, hydraulic, relief, mudline, flowoff, instrument valves, and strainers are included. EDWARD VALVES, INC.

Vibration and noise control

600-Silence with snubbers

Explosion resistant snubbers, known as the BEC, BES, and BEO lines, for commercial, standard, and optimum silencing respectively, are described in eight-page Bulletin 252. Each type is shown in an elevation drawing accompanied by photos of typical installations in industry. BURGESS-MANNING CO.

Water supply and treatment

597-Clean your boiler in operation

How to clean your boiler while in operation is explained in four fact-filled pamphlets. The Ever Clean boiler process removes rust, prevents corrosion, and increases boiler efficiency. Also includes data on solving algae problems. NORTH AMERICAN MOGUL PRODUCTS.

598-Meet the film-forming amines

"Film Forming Corrosion Inhibitors Also Aid Heat Transfer," four-page Technical Paper No. 129, contains references to protection afforded by filming amines and attendant reduction in maintenance costs secured through protection against corrosion. W. H. & L. D. BETZ.

599-Recirculation treatment chart

A method for protection of cooling water equipment and recirculating water systems is presented in Bulletin 68. Includes handy check chart to help indicate if your system would benefit from this treatment, and explains how the method works. Four pages. NATIONAL ALUMINATE CORP.

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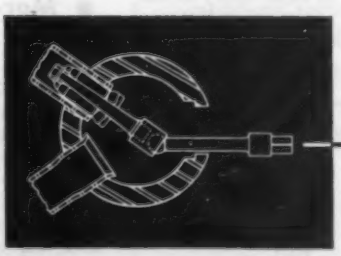

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● Organizing for certified lighting

Los Angeles becomes the 11th area to organize a Certified Lighting Bureau, according to the National Lighting Bureau. Certified Lighting Program certifies lighting plans as meeting national standards for lighting levels. Installations are warranted to conform to the lighting plan by the installing contractor. Some 86 electric contractors are lined up in Los Angeles. Training courses, part of the program, will have an overflow enrollment. . . . Special meeting of Canadian lamp and fixture manufacturers in Toronto developed a plan to form a Canadian Lighting Bureau. Main object of the proposed Bureau will be to promote better lighting, with the aim of increasing the Canadian market for lighting equipment. Bureau will attempt to correlate activities presently being carried on in Canada with three U.S. lighting promotion groups.

● Investment casting improves pump impellers

Close observation of investment-cast stainless steel pump impellers compared to similar composition sand-cast impellers used in identical service conditions indicates that investment casting offers greatly extended life in corrosive service. Type 20 stainless alloy impellers for Eco Centri-Chem, a small corrosion resistant centrifugal pump, were investigated. Investment-cast impellers resisted corrosive attack from 3 to 5 times longer than sand-cast impellers. Increased resistance is due primarily to smoother surface finish, particularly noticeable in areas that are difficult or impossible to finish by grinding. Studies also show that investment-cast impellers cut down friction loss and provide smoother, faster fluild flow.

● American Standards growing fast in last eight years

At the recent 37th annual meeting of the American Standards Association it was announced that Standards now in use exceed 1500. This is double the number of American Standards in national use in 1948. Many of the 1500 standards have been revised, some several times. American Society for Testing Materials submitted the 1500th standard to ASA. It is the American Standards specifications for nickel-chromium-iron alloy seamless pipe and tubing, one of three ASTM specifications for nickel. One is for monel metal. Another covers nickel seamless pipe and tubing.

● Fuel for aluminum

Pittsburgh Consolidation Coal Company will supply fuel needs of two 225,000-kw electric power generating units, one providing power for an aluminum plant to be built by Olin Mathieson Chemical Corporation on the Ohio River near Moundsville, W. Va. Output of the other power unit, to be owned by American Gas and Electric Company, will be distributed over their powerlines to other consumers. Involved in Pitt-Consol's portion of this project is the development of a new mine, yet to be named, and the design and erection of a coal processing plant to produce boiler-fuel char plus liquids to be refined into chemicals. The mine will be engineered for an initial capacity of 2 million tons annually. Coal reserves presently assigned to this mine are about 120 million tons. On a site between the mine mouth and the power station, Pitt-Consol will build a coal processing plant and facilities for refining and separating liquids recovered from the coal.

● More and more motors per worker

A leading electrical manufacturer has predicted that by 1965 each U.S. worker will use as much electricity every working hour as it takes to light 1000 one-family homes. Industrial use of electricity is expected to increase from the present 10 to about 20 kwh per man-hour within the next 10 years. Trend is already noticeable in food processing industry, where workers merely watch for machine errors as batteries of production equipment move products onto a conveyor.

● Present oil testing inadequate

ASTM standard test gap for measuring dielectric strength of oil is increasingly ineffective for indicating actual strength of modern power transformers, according to General Electric Company. Uniform-field gap with modified hemispheric electrodes, larger volume of oil in the test cup, and a small agitator to keep the oil in circulation during testing has been developed in the company's High Voltage Laboratory. Recognition by ASTM will be recommended as soon as details have been worked out. Testing with the standard gap gives only gross measurement of oil degradation caused by suspended particles of moisture and other contaminants. This new uniform-field gap is sensitive to moisture and contaminants dissolved in the oil in parts per million, and also suspended particles.

● More new plants on the way

Warner Electric Brake & Clutch Company will complete a second $1-million manufacturing plant near Beloit, Wis., for manufacture of small wheel brakes, air-conditioning clutches, and electric fan clutches . . . . Selas Corporation of America has just moved from its Philadelphia site to a new million-dollar plant just outside the city. Selas manufactures heat and fluid processing equipment for all industries . . . . A $2-million expansion of Stran-Steel Corporation's manufacturing plant at Terre Haute, Ind., will increase manufacturing space by about 20 percent . . . . The Peerless Electric Company recently opened a new $350,000 fan and blower division plant as first step in a half-million dollar expansion program . . . . Edward Valves, Inc., a subsidiary of Rockwell Manufacturing Company, is doubling the size of its Research Laboratory. One section will be devoted to development, assembly,

and final testing of nuclear power valves.... Air Reduction Sales Company, Division of Air Reduction Company, Inc., is planning a $16-million expansion program for this year. Three new producing plants are scheduled for completion this year at Chicago, Ill., Alton, Ill., and Calvert City, Ky. Additional facilities will also be installed at Butler, Pa., and output will be increased at Riverton, N. J.... The Wayne Pump Company has just opened a new plant in Salisbury, Md. that covers more than 18 acres.... Container Corporation of America has agreed to purchase, subject to zoning, a 48-acre tract of land near Renton, Wash., for manufacture of folding cartons.... Chrysler Corporation has just broken ground in Twinsburg, Ohio, for construction of a huge new stamping plant.... Fenwal Inc., manufacturer of temperature controls and fire detectors, has just added approximately 100,000 sq ft of manufacturing space to its Ashland, Mass. plant.... American Crucible will build a new $100,000 building to house its Kenco Pump Division, manufacturers of sump, bilge, and circulating pumps.... Dow Chemical Company will build a new plant for production of synthetic latex at Pittsburg, Calif.... Rockwell Manufacturing Company has bought a new 106,000-sq ft plant at Statesboro, Ga., from General Instrument Corporation for manufacture of meters and valves.... B. F. Goodrich Company is increasing its Miami, Okla. plant with a $4-million expansion program for increased tire production.... Horsburgh & Scott Company, Cleveland, Ohio, has made a 22,000-sq ft addition to its plant for manufacture of large speed reducers.

● Companies continue combining

Thomas A. Edison Inc., through its wholly owned subsidiary Measurements Corporation, has acquired the business and assets of Linear Equipment Laboratories, Inc., manufacturers of electronic test equipment. . . . General Electric Company has purchased substantially all the assets of the Watson Flagg Machine Co. of Paterson, N. J. Watson Flagg has supplied the gear components of most of General Electric's gearmotor lines for the last 25 years. . . . The General Tire & Rubber Company has acquired stock interest in the A. M. Byers Company of Pittsburgh, and discussions relative to a merger are in progress. . . . Dorr-Oliver Inc. has acquired all the business and substantially all the assets of Merco Centrifugal Co., manufacturers of centrifuges, centrifugal screens, and strainers... The Swartwout Company has sold its Power Plant Equipment division to Republic Flow Meters Company. Republic is establishing a Swartwout Division to carry on engineering, manufacture, sales, and service of Swartwout's line of steam specialties.

● Another hike for coal costs?

Although the Interstate Commerce Commission only made Ex Parte 175 increases permanent in October, the railroads are reported to be planning to seek another rate rise immediately. Amount is rumored to be a seven-percent hike, with a proposed increase in coal rates of a flat 10¢ per ton.

● Another power plant for AG & E

Plans for construction of a major steam-electric generating plant in southwest Virginia by the Appalachian Electric Power Company have been announced by Philip Sporn, president of the Appalachian and the American Gas and Electric Company. Station will be built on property of the Clinchfield Coal Corporation. Clinchfield is setting aside 40 million tons from its large reserves to supply the new plant over a 30-year period. Power station will be known as the Clinch River Plant, will have an initial generating capacity of 450,000 kw, and will cost $55 million. Two 225,000-kw generating units together will consume a total of 1.3 million tons of coal per year. Work is expected to start in April. Both units are scheduled for completion in 1958.

● Dacron reinforces industrial V-belts

Dacron polyester fiber is now being used as reinforcing material for premium industrial V-belts. Field tests show that premium belts reinforced with Dacron are capable of transmitting up to 40 percent more power than belts made with conventional reinforcing fibers. Belt users report life to be from 50 percent to 250 percent greater than with V-belts of similar power ratings reinforced with conventional fibers. Generally, five premium belts reinforced with Dacron fiber will do the work of seven belts made with conventional reinforcing fibers.

● Nickel figures for '55

Free world nickel production in 1955 again set a record with output estimated at about 427 million pounds. This is an increase of approximately 40 million pounds over the previous high (1954), and 87 million pounds over free world production in 1953. Total output by Canadian producers is expected to reach 347 million pounds in 1955—some 24 million pounds more than 1954. Of the remaining free world production, Cuba accounted for approximately seven percent, New Caledonia for about five percent,

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spot news

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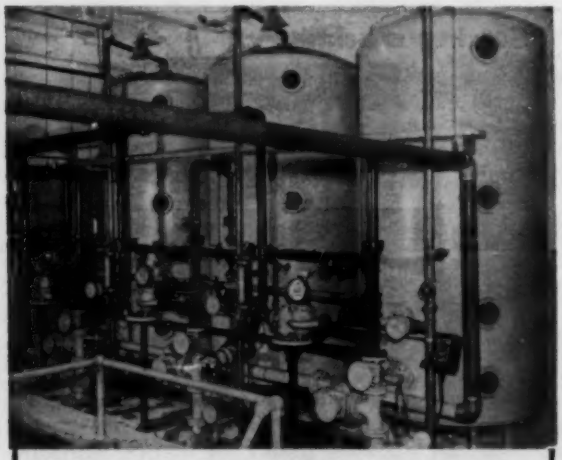
Japan about three percent, United States two percent, and various other countries two percent. Throughout the year, basic prices for Canadian nickel to industrial consumers in all world markets remained unchanged at 64½¢ U.S. currency (including the 1¼¢ U. S. import duty).

● Steel sets another record

For the second straight week (the week ending January 21), steel ingot production set an alltime record with output at 99 percent of capacity and tonnage measured at 2,437,000. This is a yearly rate of 126 million tons. Actual 1955 production was 117 million tons. So far, demand has shown no signs of subsiding. Record output in the first six months seems assured despite the letup in auto production that has been forecast.

● Some prices are coming down

Major price reductions have been made on all germanium rectifiers made by Hanson-Van Winkle-Munning Co. Some prices are reduced as much as 25 percent, depending on voltage and type of voltage control. Price reduction is attributed to an improved germanium manufacturing technique. In some cases, prices of garmanium rectifiers will now be no more than those of comparable selenium rectifiers. . . . Completion of a final unit in a $16-million plant expansion program is reflected by a 7½-percent reduction in Dow Corning Corporation's price of dimethyl silicone fluids and emulsions. New facilities will more than double the previous methyl siloxane capacity of the corporation. Prices will now be less than half their original level.



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● Generator orders in the news

First large steam turbogenerator with liquid-cooled stator conductors has been shipped from General Electric Company to the Cleveland Electric Illuminating Co.'s station at Eastlake, Ohio. Unit, which consists of a tandem-compound turbine rated at 208,000 kw and its connected generator (rated capable of producing 260,000 kva), will be the largest 3600-rpm turbogenerator in the world. . . . Steam turbogenerator for the New England Electric System on order from General Electric will be housed in an expansion of the system's Salem Harbor station, Salem, Mass. Unit will have a generating capability of at least 125,000 kw, and the turbine will be a tandem-compound, triple-flow reheat type. . . . Commonwealth Edison Company has ordered a 305,000-kw steam turbogenerator from General Electric for its Waukegan power station. It is expected to go into service in 1958.

● More fuel burned, more electricity produced

Electric utility power plants consumed a record 13,285,194 tons of coal in November, an increase of 4.9 percent over October, and 24.2 percent above consumption in November 1954. Fuel oil consumption during November totaled 7,095,776 barrels — 21.9 percent above November 1954 consumption. Use of gas amounted to 82,264,323,000 cu ft during November, a decrease of 6.9 percent from consumption in November 1954. This was also 21.5 percent below consumption in October. . . . Production of electric energy by utilities totaled 47,757,306,000 kwh in November, an increase of 18.8 percent above November 1954, and 0.8 percent above October. Industrial production, including generation by railway and railroad plants, was 6,761,559,000 kwh in November — an increase of 8.5 percent over November 1954.

● Geothermal power on the way?

Geothermal power may someday take its place with atomic and solar energy as a source of electricity. Minneapolis-Honeywell Regulator Company reports that its engineers are working with New Zealand utilities in planning geothermal power stations. These stations will tap that nation's extensive hot springs, using subterranean steam to generate electricity.

● Water program needs overhauling

Entire Federal program for water resources and power development is "honeycombed with subsidies, open and hidden" and a "major overhaul of existing procedures" is needed to bring about sound and consistent Federal policies in this important field. This opinion was given by Admiral Ben Moreell, chairman of the Task Force on Water Resources and Power of the Second Hoover Commission, in addressing the Conference on Water Resource

Policies in St. Louis recently. He said, "Water and power activities should be reexamined in the light of what is sound business practice and good public policy — irrespective of the legal extent to which they can be expanded under contemporary interpretations of the Constitution."

● Westinghouse strike loss exceeds $1 million last quarter

Losses due to strikes at 40 Westinghouse Electric Corporation plants through most of the fourth quarter of last year amounted to $1,037,000 or 9¢ a share. Fourth quarter net sales billed amounted to over $306.5 million, and was derived from 58 plants which have been unaffected by strikes, from struck plants where 5000 employees have crossed the picket lines to return to work, and from subsidiary companies.

● Aluminum eliminates odor

Aluminum has now proved to be sweet smelling, according to a report recently given before the ASHAE. Results of extensive research reveal that aluminum coils treated with chromic or phosphoric acid are least subject to air-conditioning coil odor. Air-conditioner odors are caused by various substances accumulating on coil surfaces. Coil odor usually occurs for several weeks during September and October, particularly when a long spell of hot weather suddenly moderates. Direct comparison of all-aluminum coils, copper tubes with aluminum fins, and all-copper coils indicates that the all-aluminum type ranks first in resistance to coil odor.

● Portable gas turbines as starters

Solar Aircraft Company will build a number of Jupiter gas turbine portable compressor packs for the Air Force for use in starting turboprop and turbojet aircraft engines. Most of the output from these 500-hp gas turbine engines is in the form of compressed air, bled from the compressors. Units will be mounted on self-propelled dollies and will use the same fuel as the engines being started up.

● Engineering and education

Last year, the General Electric Educational and Charitable Fund netted the nation's colleges and universities approximately $400,000 — nearly $200,000 from the Fund and a like amount from alumni. This year, the program will be broadened to permit matching of contributions from General Electric employees to colleges and universities which they attended at least one academic year, even though they did not obtain a degree. Gifts up to $1000 per employee will be matched by the Educational and Charitable Fund. . . . An organization called Junior Engineering Training for Schools (JETS) is bringing facts of engineering to a growing number of young people and may definitely improve America's stock of trained engineers. This 4-H club of engineering, originated by Michigan State University, tells high school students what engineering is and what opportunities it offers. Program is proving effective not only in stimulating interest in engineering, but also in steering some students, whose talents are in other areas, away from engineering. This effect of the program will reduce engineering "dropouts."

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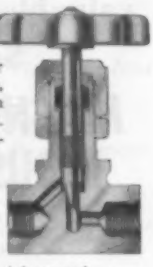

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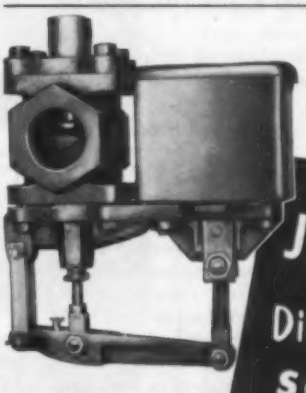

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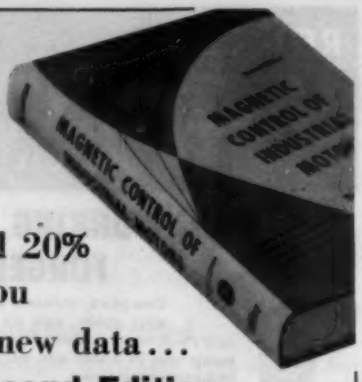

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The Selection and Design of Refractory Ignition Arches for Single Retort Stokers, by T. S. Spicer and R. J. Grace; Pennsylvania State University; 14 pages; 75¢.

This book is designed to acquaint users of bituminous coal with the benefits to be derived from the use of refractory ignition arches with single retort underfeed stokers. Information presented should be sufficient to allow the engineer to select, design, and install arches where firebox conditions warrant their use. The problem of inefficient combustion and its solution are thoroughly discussed with the aid of detailed diagrams. The book is well worth reading if you have this type of stoker.

Design, Operation & Maintenance of Hydraulic Equipment for Use with Fire-resistant Fluids; National Fluid Power Association; 20 pages; 30¢.

General information on basic characteristics of the different types of most commonly used fire-resistant fluids in the hydraulic field is presented in this book. Physical properties are tabulated. An extensive bibliography is included for those who want more detailed information.

Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, Volume 3, Power Reactors; United Nations; 392 pages; $7.50.

This volume comprises those proceedings of the International Conference on the Peaceful Uses of Atomic Energy that referred to power reactors. It provides a complete summary of reactor technology as of August 1955. In fact, it is the next best thing to having been present at the sessions themselves.

Contents are divided into six sessions, covering fuel cycles, experience with nuclear power plants, design of reactors for power production, power reactors, and prototypes. Thirty papers are reproduced verbatim with appropriate illustration. At the end of each session division, there is a record which includes the discussion that followed the session. A nuclear reactor catalog concisely tabulates unclassified features of reactors now in operation and summarizes reactor development. Typography is modern and illustrations are very well reproduced. The book is well bound, so it can serve as a reference for many years. Between its cover is a wealth of experience that should be a valuable reference for all engineers interested in nuclear power.

Bibliography on Machinery Foundations; Design, Construction Vibration Elimination; The Engineering Societies Library; $2.00.

This is a revised list of 175 annotated references to selected books and articles published since 1924. They cover theory, design, and construction of foundations; specific problems; and vibration as related to machinery foundations.

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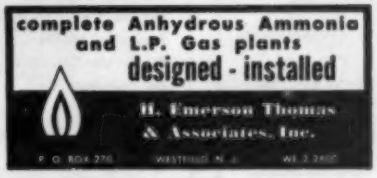

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Apr. 1-5	ASME Oil, Gas, and Power Conference	Jung Hotel New Orleans
Apr. 2-4	AIEE Southwest District Meeting	Dallas
Apr. 5-7	Eighth Biennial Electric Industry Show	Shrine Hall Los Angeles
Apr. 16-17	ASME Gas Turbine Power Division Conference	Hotel Statler Washington, D. C.
Apr. 16-18	AIEE Great Lakes District Meeting	Fort Wayne Indiana
May 2-4	AIEE Northeast District Meeting	Rochester, N.Y.
June 17-21	ASME Semiannual Meeting	Statler Hotel Cleveland
June 25-29	AIEE Summer and Pacific General Meeting	San Francisco
Sept. 10-12	ASME Fall Meeting	Denver
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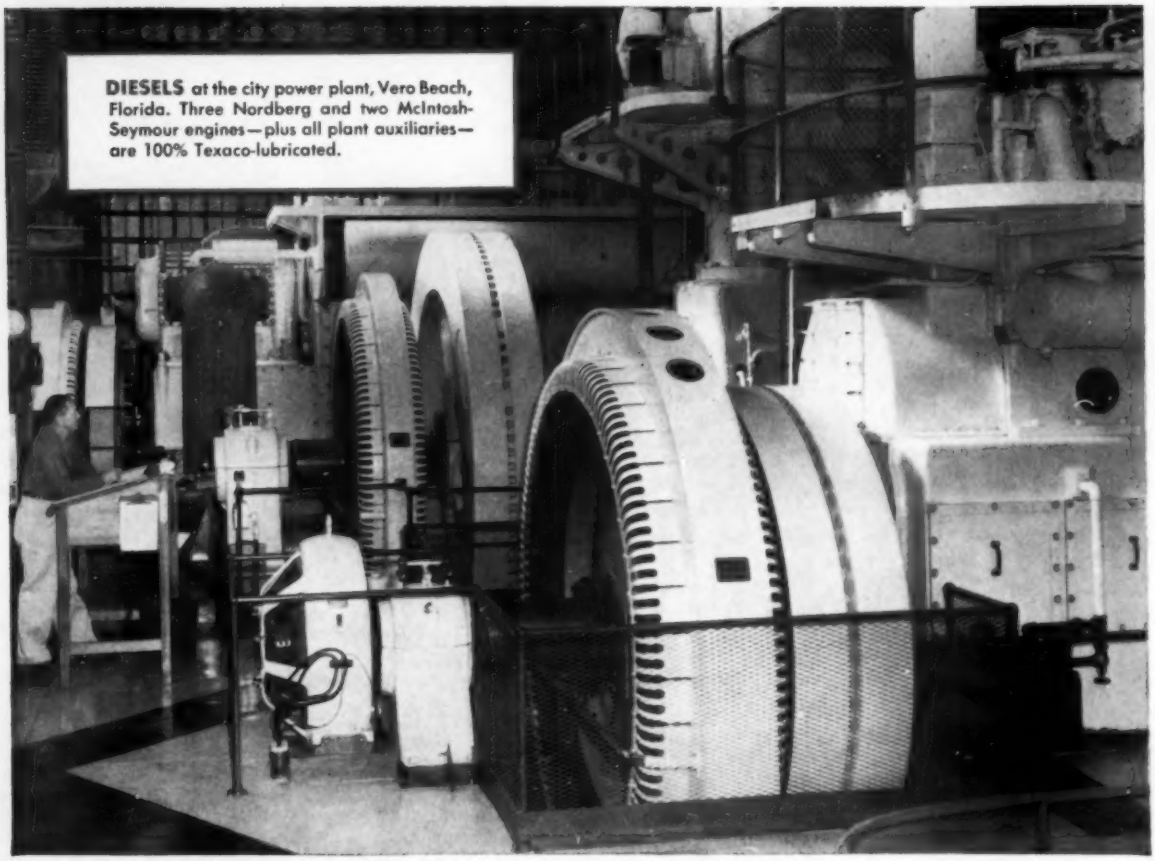

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